Anticipating Social Effects of Coastal Restoration Projects

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Robert Gramling
University of Louisiana at Lafayette

Shirley Laska
Center for Hazards Assessment, Response and Technology, University of New Orleans

George Wooddell
University of Louisiana at Lafayette

Craig Forsyth
University of Louisiana at Lafayette

JoAnne Darlington
University of Louisiana at Lafayette

Broderick Green
Center for Hazards Assessment, Response and Technology, University of New Orleans

Bill Kappel
Center for Hazards Assessment, Response and Technology, University of New Orleans

Becky Boudreaux
Center for Hazards Assessment, Response and Technology, University of New Orleans

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Abstract

This project takes a systematic approach to assessing and predicting the social impacts of specific coastal restoration projects . The project is organized around two fundamental thrusts: Examining existing restoration projects to begin a compilation of the social impacts of such projects in order to utilize what we learn about the post hoc analysis of existing projects to predict the effects of proposed future projects. Three existing diversion projects – Teche/Vermilion, Caernarvon and the Wax Lake Outlet – are examined for their unique contributions to knowledge concerning social impact and two proposed projects – The Reintroduction of Mississippi River Water into Bayou Lafourche and the Third Delta Conveyance Channel – are compared using the knowledge gained. The lesson to be drawn is a simple one, that it is time to recognize that some projects cannot be done because of social considerations and stakeholder interests and some can be done more easily for the same reasons and that **these considerations need to be taken into account up front.** In short, we need first to look for opportunities where restoration projects – given their size and configuration – **can** happen and/or be allowed to fully function before we do extensive engineering or ecological analysis.

1.0 Introduction

Because of a variety of geologic processes--subsidence, erosion, the containment of the lower Mississippi River, coastal oil and gas exploration and extraction operations, Louisiana is losing coastal wetland faster that anywhere on the continent, and perhaps on the planet. In an attempt to address this problem federal legislation, e.g. The Coastal Wetlands Planning, Protection and Restoration Act of 1989 (CWPPRA), and a variety of local and state agencies and organizations have focused on restoration activities in coastal Louisiana. There are 141 CWPPRA projects alone that have been completed, are underway or under consideration. The U.S. Army Corps of Engineers (the Corps) and the State of Louisiana have a massive restoration program in the planning stages. The Louisiana Coastal Area (LCA) proposes restoration be undertaken with a larger, regional perspective rather than individual projects. In addition, ad-hoc emergency restoration projects with little or no notice have been undertaken in response to storm disasters. When tropical storm Isadore washed away portions of the Grand Isle protection levee in 2002, the mayor of Grand Isle and the Governor's office found the funds to repair it before hurricane Lili struck one week later. Indications are that restoration projects along the Louisiana coast will continue to grow in number and scope.

1.1 The Problem

Many coastal restoration projects that have been well thought out from an engineering/ecological/geologic perspective have been challenged by inadequate prior assessment of the ways in which they will affect the human communities and individuals that live within the impact area, especially those community members who engage in long-practiced commercial or recreational uses of the areas (Laska, Emmer and Darlington 1993). The result has been unintended and previously unrecognized social impacts, both positive and negative. When unanticipated negative effects of a restoration project have become evident to various community stakeholders, opposition and mobilization to question, alter, or stop the project has resulted.

When this has happened reactive attempts have occurred to mitigate these community stakeholders' claims after the project is under way, or completed. However, strong opposition to some aspect of the project has sometimes emerged and very public discussion of the impacts has ensued because the proposed mitigation is assessed as inappropriate or inadequate. Once the conflict has become public, and particularly once litigation is joined, the problem becomes much more intractable (Gramling 1996; Margavio et al. 1993). Such scenarios ultimately reduce the ecological restoration benefits of the projects because human user and local community resistance affects the speed and magnitude of the implementation of the project.

While a certain amount of disagreement and conflict is probably inevitable with any large coastal restoration project that potentially affects natural (and frequently publicly held) resources (Laska et al. 1993), attempts to mitigate coastal community stakeholder impacts, up front, before project initiation, or even project planning, has been found to increase the ecosystem benefits of the project as well as the benefits to the resident communities (Emmer et al. 1992).

This project takes a systematic approach to assessing and predicting the social impacts of specific coastal restoration projects and will explore additional ways to anticipate, mitigate, or avoid those which are negative and/or perceived as negative by community stakeholders. In a nutshell, we are suggesting a more comprehensive method to project the effects of proposed restoration activities before they take place, utilizing information collected from past restoration activities. Such a method should better allow planners and other interested parties to more confidently anticipate the effects, maximize the benefits and minimize the potential costs of their activities. In summary the project is organized around two fundamental thrusts: examining existing restoration projects to begin a compilation of the social impacts of such projects in order to utilize what we learn about the post hoc analysis of existing projects to predict the effects of proposed future projects.

Interviews and documents examined early in this project resulted in the conclusion that diversion projects are the most likely type of project to bring about major changes and are also the most likely type of project to result in controversy. Accordingly, we made the decision to focus on diversions as the most useful type of projects for the assessment of social impacts. Also as a result we have modified the scope of the project slightly by not restricting it only to CWPPRA projects. Our interviews and document reviews have led us to the conclusion that the two most instructive potential future projects are the ones proposed for the Bayou Lafourche region. These projects are the reintroduction of Mississippi River Water Reintroduction Into Bayou Lafourche, CWPPRA project PBA-20 or some variation thereof, (Environmental Protection Agency 1998) and what has been called the "Third Delta" Conveyance Channel Project (probably best summarized by Gagliano and van Beek 1999).

The current study was originally conceived for and funded by the Governor's Applied Coastal Research and Development Program as a two year project during which the researchers would approach a social impact analysis of two or three proposed coastal restoration projects by identifying and assessing the impacts of prior similar projects and projecting them to the proposed projects. Once the two diversion projects were chosen, however, it was recognized that these are complex projects that are far-reaching in their implications. As a result, the Governor's Applied Coastal Research and Development Program has been joined by the Louisiana Department of Natural Resources, to expand the study and extend it for a third year.

1.2 Social Impact Assessment

1.2.1 National Environmental Policy Act

Assessing social and economic impacts, or those impacts that directly, or indirectly affect the human environment comes out of two traditions both approximately three decades old. The first impetus came about because of the National Environmental Policy Act (NEPA) 1969. NEPA required that federal agencies or other agencies using federal funds, assess and attempt to mitigate the effects of their proposed actions prior to implementation. And in so doing to "utilize a systematic, interdisciplinary approach which will insure the integrated use of the natural and social sciences and the environmental design arts in planning and in decisionmaking which may

have an impact on man's environment."(102 [42 USC § 4332] (A)).

NEPA led to the birth of a variety of social impacts assessment techniques, probably best summarized by Field and Burch (1988), and condensed into guidelines by the Interorganizational Committee on Guidelines and Principles for Social Impact Assessment (1993).The focus of this approach is to assess potential social and economic impacts before activities occur. This approach focuses heavily on establishing baseline conditions (understanding how the basic social and economic environment functions prior to the relevant activity), scoping (identifying the full range of probable social impacts based on discussions with the affected parties) and projecting responses to the most probable impacts (and how they will play out). NEPA inspired social impact assessment is, thus, predictive in orientation.

1.2.2 Boomtowns

Although the social sciences have since their inception been concerned with cause and effect relationships, the second impetus, to specifically assess impacts of development activities after they happen arose in the early 1970s out of the examination of the effects of the construction of coal fired generating plants, located near large deposits of coal, in the rural western United States. The construction of these plants required large temporary labor forces which were suddenly located in small rural communities contiguous to the new plants. The alleged "social pathologies" that seemed to erupt attracted the attention of researchers, leading to the emergence of a focus on establishing the causal relationship between activities that alter the physical and social environments and the subsequent social and cultural changes. The initial driving force behind this "boomtown" model was population growth which led to a host of associated, frequently deemed undesirable, effects such as over crowding, breakdown of various municipal services, decreases in the density of acquaintanceship with subsequence loss of informal control of deviance and support of the community disadvantaged (Freudenburg 1986), to increased rates of substance abuse, divorce, homicide and suicide (see Albrecht 1982; Bates 1978; Cortese and Jones 1977; Gilmore 1976; see Gramling and Brabant 1986 for a concise description).

The attention to effects that can be observed after disruptive activities has broadened beyond population growth as the almost single driving mechanism, but the emphasis has remained on post hoc analysis. Thus, one tradition of social impact assessment focuses on predicting what impacts will happen before the introduction of a particular activity and the other focuses on examining the causal links between the activity and subsequent changes after they have happened. However, in this project we have set ourselves up to do both, since our strategy is to examine existing diversions, delineate their relevant impacts and make projections, based on that knowledge, of what the important potential impacts of two diversion projects will be. This is rarely done (but see National Research Council 2004) and will require a synthesizing analytical framework.

1.3 Analytical Framework

In attempting to provide a more flexible tool for assessing social impacts Gramling and

Freudenburg (1992; see also Freudenburg and Gramling 1992) developed a typology that allowed assessment over both time and the various human systems that are affected by the types of changes potentially brought about by developmental activities. On a temporal basis these effects can be separated into opportunity/threat impacts, developmental impacts and adaptation/post developmental impacts.

1.3.1 Temporal Sequence

1.3.1.1 Opportunity/Threat Impacts

In the physical sciences, it may be accurately asserted that impacts do not take place until actual alterations of physical or biological conditions have happened. With the human environment, however, real, measurable impacts start with alterations in social conditions. These frequently occur in the form of information about an impending activity. These "opportunity/threat" impacts (Freudenburg and Gramling 1992; Gramling and Freudenburg 1992) result from the efforts of interested parties to define, and respond to, the anticipated effects of development scenarios, either as opportunities (for those who see the potential effects as positive), or as threats (for those who see them as negative).

Opportunity/threat impacts occur with virtually all development activities and are particularly noticeable with activities or facilities that are large, controversial, risky, or otherwise out of the range of ordinary experiences for the local community or region. They commonly occur as speculators buy property, politicians maneuver for position, interest groups form or redirect their energies, stresses mount, and a variety of other physical, cultural, social, political, economic, and psychological impacts take place. These impacts have sometimes been called "anticipatory" or "pre-development" impacts, but they are far more real and measurable than such terminology might imply (Krannich 1995).

A point that bears repeating here is that we are not talking about expected impacts, but with actual impacts -- significant, empirically verifiable changes, that would not have taken place but for the announcement of a proposed development, the actions that were taken to encourage, discourage, or otherwise influence the outcome of the proposed development, and the social definitions of the development that emerge as a result of such negotiation processes (cf. Freudenburg and Gramling 1992). In these negotiations, moreover, project proponents and relevant government agencies are far from being impartial observers; in fact they are key participants. Their behavior, as well as the behavior of community residents, can have considerable influence on the type and extent of opportunity-threat impacts associated with proposed activities.

1.3.1.2 Developmental Impacts

The majority of the literature on impacts to the human environment has involved developmental impacts, or those impacts associated with the actual construction/development and/or operation of a project, or the onset of a particular activity or process. Development impacts have most

frequently been studied and consequently are the best understood.

1.3.1.3 Adaptation/Post Development Impacts

With human environments the question is not whether adaptation will occur. Virtually by definition, human environments do adapt to impacts -- indeed, cannot fail to do so even in extreme situations (Bettelheim 1943). The issue is not that the various systems, physical, cultural, social, political, economic, or psychological fail to adapt, either to externally generated perturbations or to internally negotiated threats and opportunities, but rather what the consequences of adaptation are. As the various components of the human environment adapt to a new development activity new skills, knowledge, tools and resources may become available to support traditional activities. Two potentially problematic things can also occur. First, the old patterns of behavior, economic activity, skills, capital improvements, may be lost (sometimes quickly, sometimes across generations) because they are no longer relevant. Second, human and financial capital and non-renewable resources may be, and usually are, actively committed to the new development scenario. If the new development activity is not a sustainable one, when it ceases, or declines, communities or regions may be in the position of now being less able to survive in their environment than before the new development came along. This "overadaptation" (Freudenburg and Gramling 1992) is frequently associated with out migration, and is exacerbated by isolation. In a populated region with a mixed economy the decline in a dominant activity will usually cause some disruption and population dislocation. The migration out of the "rust belt" in the late 1970s is an example. In more isolated rural areas the economic and population dislocation can be more dramatic (e.g. Appalachia).

1.3.2 Impacted Systems

While there can be significant overlap, opportunity-threat impacts can be seen as having implications for six systems of the human environment.

1.3.2.1 Biophysical and the Built Environment

Activities that change the physical environment, or that are perceived to have the potential to change the environment can have ripple effects. This is particularly true in rural areas where the effect, or perceived effect, involves traditional economic activities such as fishing or farming. Impacts can occur as individuals and groups engage in alterations of the physical environment, based on anticipated future development. These may include the development of coastlines or harbors, renovation of transportation routes and facilities, or upgrading of community infrastructure and/or health or social services. Initial decay of existing facilities, due to lack of maintenance (in anticipation of new jobs or activities), may also occur during this phase. Less commonly recognized is the fact that proposed developments can also be interpreted as opportunities for direct improvements to the environment or public health. As of this writing (2006) the State of Louisiana is actively negotiating with the federal government to capture more of the revenue generated by offshore oil and gas activities, specifically to address the negative impacts of those activities.

1.3.2.2 Cultural systems

Developments and other external activities most obviously affect indigenous or native cultures, whose very survival may be threatened by increased contact with mainstream industrialized cultures, and increased integration into the cash economy during the planning stage of development. To a lesser extent, these same impacts occur in so-called "mainstream" rural communities. Cultural systems are normative in nature, that is, they define how people should think and act, particularly as they relate to one another. Changes in traditional occupations, exposure to external values and norms, and the necessity to increasingly interact with alternative world views, whether to understand proposed projects, or to adapt to new local occupational realities, can bring about fundamental changes, particularly in rural communities. Proposals for new developments, and the ensuing battles, can also threaten citizens' views of how the world "ought" to work, with respect to expected and actual actions of governmental and other authorities (cf. Finsterbusch 1988; Edelstein 1988; Clarke 1988).

1.3.2.3 Social systems

Impacts to social systems occur with new forms of social organization; as interest groups form or redirect their energies, promoting or opposing the proposed activity, and engaging in attempts to define the activity as involving opportunities or threats. Interaction patterns change, old friendships are lost, and new ones made. As development continues potential threats include the risk of the disruptions that have characterized large-scale industrial developments in rural areas, such as increased crime (Freudenburg 1986a; Krannich et al. 1984), drug and alcohol abuse (Milkman et al. 1980; Lantz and McKeown 1979), mental health problems (Freudenburg et al. 1982; Bacigalupi and Freudenburg 1983), or even deterioration of the sense of community. These changes can continue as development progresses and individuals and communities adapt to the new conditions brought on by the developmental activity. Alterations in salinity regimes could, for example, bring about necessary changes in coastal economic and recreational activities, leading to new social networks oriented toward shifts in availability of salinity sensitive aquatic species.

1.3.2.4 Political/Legal systems

Some of the most contentious of all opportunity-threat impacts come through the altercations surrounding litigation, and or political activities, in favor of, or opposed to, a project or activity. In recent Louisiana history the litigation surrounding the Caernarvon freshwater diversion project is a case in point. Not only did numerous law suits result from this project, but political manipulations have taken place at the highest levels of state government, resulting ultimately in a constitutional change.

The litigious nature of the debate over the perceived opportunities and threats associated with large projects can greatly increased the tendencies toward intractable positions in coastal communities and state and federal agencies. Legal processes start from the assumption that the relevant parties are adversaries, and often exacerbate the degree to which the process becomes

adversarial. Once the conflict enters the arena of litigation, the lawyers for all parties insist the parties must not do precisely what virtually all risk communication literature insists that people must do, which is to start talking to the other side (see e.g. Hance et al. 1988; Gramling 1996). The net result is a spiral of stereotypes. Once the information loop is severed by the litigation process, individuals on both sides begin to talk, not to the other side, but about the other side. Experience shows that, lacking any real data, they will make it up, so that rumors and speculation become, for both sides, the primary sources of information about one's adversaries.

1.3.2.5 Economic systems

With economic institutions, the threats often receive less early attention than do the opportunities. The opportunities include potential increases in business revenue and in real estate values, but primary attention is often devoted to the possibilities for new jobs-- even though findings suggest that such jobs often prove to be less numerous than is commonly assumed (Molotch 1976; Summers et al. 1976). The Mississippi River Gulf Outlet (MR-GO) was sold as an economic boom/jobs project, although it has failed to live up to the original hype. The controversy over MR-GO as an economic development project continues to, and has exacerbated during, this research, with proponents justifying the re-dredging of MR-GO after its closing following siltation from hurricane Katrina and opponents demanding its closure and blaming the project for the flooding of major portions of New Orleans during hurricane Katrina.

Still, there are many examples of jobs having been created locally. In southern Louisiana, offshore oil development has largely been defined as an opportunity, providing tens of thousands of coastal jobs. In part, this is because of the relatively good fit between the Outer Continental Shelf jobs and the local human environment.

1.3.2.6 Psychological systems

Finally, the proposals and the battles over the social meanings (threats and/or opportunities) of the proposals, dislocations and inconveniences during development and physical relocations, job changes in order to adapt to new conditions may create stress for psychological systems. Not only can the perceived threats of a development, and the contentiousness surrounding the definition process, lead to anxiety and stress, but the decisions that are made, and the ways in which they are made, can alter residents' ability to maintain the view of themselves as efficacious persons. Relocations in the occupational, and corresponding status, structure of the community requires new psychological grounding, which individuals and communities will accomplish with varying degrees of success.

The typology presented in Table 1.1 is designed as a conceptual tool, to assist in considering potential impacts. Within each of the cells of the table impacts may be positive, negative, both, or non-existent. The impact of a particular activity may be positive in one cell and negative in another (e.g. the development impact of MR-GO may have a positive economic impact for the region, but may have a negative physical/safety impact on St. Bernard Parish and the Lower Ninth Ward). The assessment of impacts to the human environment, thus, becomes an exercise

in identifying which of the cells need to be focused on and explored in detail and which can be eliminated from further analysis after scoping has taken place. The extent to which the classes of impacts in the typology will be present for a particular event, activity, or development, will vary widely depending on a variety of cultural, social, and geographic variables in the region being impacted, as well as on the activity or event itself.

Table 1.1: Temporal Phase of Development and System Impacted

	TEMPORAL PHASE		
SYSTEM IMPACTED	OPPORTUNITY/ THREAT	DEVELOPMENT/EVENT	ADAPTATION/POST-DEVELOPMENT
PHYSICAL	Anticipatory new construction, lack of maintenance of existing structures and facilities	Alteration of the physical environment, construction of new, and upgrading of existing, facilities	Alteration of infrastructure for new uses, deterioration of alternative production facilities
CULTURAL	Initial contact, new ideas, reaction to outsiders	New tools and skills, suspension of activities which assure cultural continuity, e.g. subsistence/traditional harvest	Application of new technologies to traditional practices, loss of unique knowledge, skills, alternative perspectives
SOCIAL	Formation of new organizations, time money energy spent for support of or resistance to proposed development	Population increases, influx of outsiders, decline in density of acquaintanceship, social change	Alteration of human capital, refocus on skills with application in new development, but possibly with limited alternative applications
POLITICAL LEGAL	Creation of new political entities, litigation to support or block proposed development	Intrusion of development activity into community politics, litigation and conflict over activity impacts, legislative action	New or altered political institutions, judicial decisions alter political landscape, emergence of new special interest stakeholder groups
ECONOMIC	Decline or increase in property values, speculation, investment	Traditional boom/bust effects, inflation, and entrance of "outsiders" into local labor market	Growth or decline of local economy, loss of economic flexibility, specialization of businesses, alteration of human capital.
PSYCHOLOGICAL	Anxiety, stress, anticipation, hope, perceived potential for gains or loses	Stress associated with rapid growth, "social pathology," family violence, loss of efficacy	Gains in efficacy, acquisition of mal-adaptive coping strategies

1.4 Selection of Projects

1.4.1 Projections

After examining a variety of proposed diversion projects on the Coastal Wetlands Planning, Protection and Restoration Act (CWPPRA) list and other less formally proposed projects, the researchers chose one that was well into the planning process and had similar size (in terms of potential water flow rates) completed projects for comparison and one that was just starting the evaluation/planning process, and was well beyond the physical scope of any previous restoration project. For the former we chose the Mississippi Water Reintroduction Into Bayou Lafourche (hereafter called Bayou Lafourche) and for the latter the Third Delta Conveyance Channel (TDCC).

1.4.1.1 Bayou Lafourche

The Bayou Lafourche project is a relatively straightforward design to reintroduce approximately 1,000 cubic feet per second (cfs) of Mississippi River water into the headwaters of Bayou Lafourche at, or near, Donaldsonville. Bayou Lafourche was an active distributary of the Mississippi River when European settlement arrived in the area and was used as a transportation and western migration route (via steamboats) throughout much of the 19th century. It was sealed off from the Mississippi in 1904, to prevent flooding, during spring high water, of the growing settlement along the natural levees of the Bayou. The communities on the natural levee of Bayou Lafourche grew throughout the 20th century and primarily took their drinking water from the bayou. With no river water and little in the way of a drainage basin, the water quality in the bayou quickly declined. In the 1950s a pumping station was built at the Mississippi River Levee to pump approximately 300 cfs of river water into the bayou, but several decades later with growing water use and salt water intrusion as far north as Lockport, water quality again became a problem. The currently proposed diversion project is primarily aimed at combating salt water intrusion to benefit the surrounding freshwater marshes, with an added benefit of providing additional drinking water to the Bayou Lafourche communities.

1.4.1.2 Third Delta

The TDCC is the most ambitious diversion project proposed to date (2006). Unlike Bayou Lafourche the Third Delta is primarily a sediment delivery project and is aimed, as its name implies, at creating new deltas between those created by the Mississippi and Atchafalaya rivers, in Barataria and Terrebonne Bays. A second goal of the project would be to combat salt water intrusion in the two bays and their drainage basins. It is not conceived of as a drinking water project, although it could conceivable be used for that purpose. The TDCC would leave the Mississippi River below Donaldsonville, through a control structure, and flow southeast just east of the natural levee of Bayou Lafourche. Above Raceland the channel would split, the western portion crossing Bayou Lafourche and the two channels paralleling Bayou Lafourche on the east and west sides. The east and west channels would empty into the upper reaches of Barataria and Terrebonne Bays respectively. In scope the project would be huge, ultimately flowing at between 200,000 and 300,000 cfs. The TDCC is in the early planning/evaluation stage. The proposed route of the project has only tentatively been put on a map, there are no engineering drawings. The physical and environmental effects are being discussed at the broad conceptual

level, and virtually no social impacts have been discussed. Accordingly, the projections of social impacts will also of necessity be couched at the broadest levels.

1.4.2 Post Hoc Assessments

The question becomes, what existing diversion projects will allow us to learn the most about specific social impacts that can be applied toward projections concerning Bayou Lafourche and the TDCC? After examining a number of projects we settled on the Teche/Vermilion Freshwater Diversion (hereafter Teche/Vermilion), the Caernarvon Freshwater Diversion Project (hereafter Caernarvon) and the Wax Lake Outlet.

1.4.2.1 Teche/Vermilion

While not intended as a coastal restoration project, the Teche/Vermilion project has several things to recommend it. First, it has considerable history behind it. Conceived in the 1950s and completed in 1982 we have a half century of planning and over two decades of operation to examine. Second, in scope, it is very similar to the Bayou Lafourche project, though as we will see the functions are somewhat different.

1.4.2.2 Caernarvon

Caernarvon was designed as a freshwater diversion targeted at mitigating saltwater intrusion into the Bretton Sound drainage basin. While ecologically it has been touted as a resounding success, it is most instructive for our analysis because of the protracted, expansive litigation that surrounded its alleged effects.

1.4.2.3 Wax Lake Outlet

While not originally designed as, or conceived of, as a diversion project, Wax Lake is the only locally comparable example we have of a human constructed channel that carries the approximate volume (up to 200,000 cfs) of the proposed TDCC. The Wax Lake Outlet is actively building a delta and in fact apparently served as the inspiration for the TDCC.

2.0 The Teche/Vermillion Project

2.1 Background

Historically the Vermilion River was never a reliable transportation artery for the Acadiana region (Gramling 1983), but in contrast Bayou Teche was *the* transportation route to and from Acadiana from the 1700s well into the 19th century. There were basically two routes into the region. The first route was directly up Bayou Teche from its junction with the Atchafalaya and larger boats used this route. However, New Iberia was the headwaters for navigation for these larger boats. As a result New Iberia became the head of navigation for deeper water transportation on the Teche, a regional supply center for the Teche Ridge and the larger Attakapas region, and the center for the commercial agricultural activities that were to follow. Smaller boats could navigate Bayou Teche above New Iberia to its confluence with Bayou Courtableau at Port Barre and from there upstream to Washington, Louisiana. Bayou Courtableau was also accessible from the Atchafalaya River during high water periods. Bayou Teche flowed into the Vermilion River through Bayou Fusilier (see Figure 2.1). Thus, the headwaters of both Bayou Teche and the Vermilion River were a part of the larger Atchafalaya drainage basin. As the railroads came to the Acadiana area in the late 1800s these waterways slowly lost relevance as transportation routes.

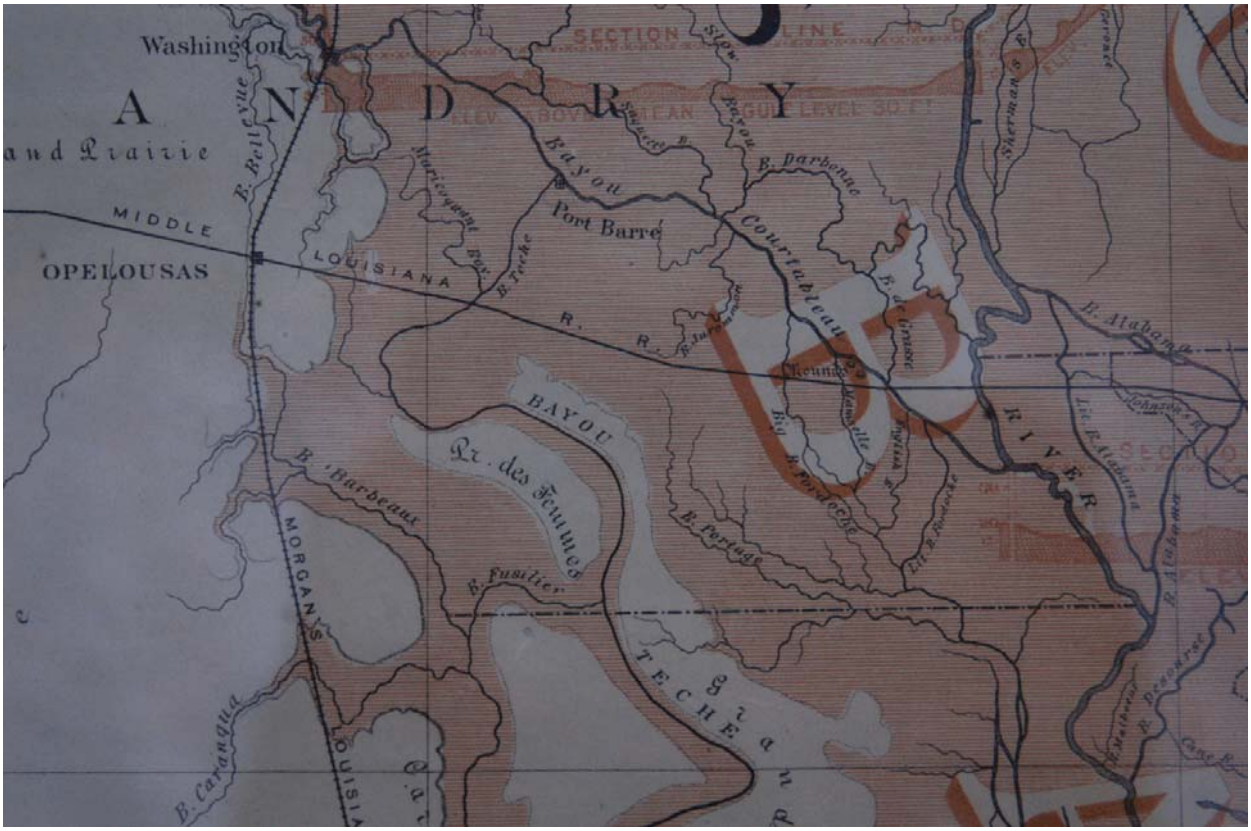

Figure 2.1: Historic Bayou Courtableau

Following the disastrous 1927 flood, and the passage by Congress of a Mississippi River Flood Control Act in 1928 (Barry 1997), the Atchafalaya Basin's main function, at least from the perspective of the Corps, became to relieve flood pressure on the Mississippi River rather than transportation. Beginning in the early 1930s the Corps constructed an extensive Mississippi and

Atchafalaya Rivers flood protection levee system. The western Atchafalaya floodway levee cut Bayou Teche and the Vermilion River off from a portion of their traditional drainage basin and ended their function as distributaries of the Atchafalaya. Severing the waterways from their traditional watershed reduced water flow, and by the 1950s the Teche and the Vermilion were touted as two of the most polluted streams in America. Agricultural runoff, sewage treatment discharge, sugar mill discharge (on the Teche) and a rendering plant north of the city of Lafayette all contributed to oxygen depletion in the two waterways and frequent septic conditions, locally called "black water."

Following the movement of petroleum exploration and production offshore, Lafayette, Louisiana became the center of offshore activity in the Gulf of Mexico during the 1950s and the area's population began to grow rapidly. The Vermilion River ran through Lafayette near the growing "Oil Center" district and the neighborhoods beginning to surround it (Gramling 1983;1996). The presence of this "polluted stream" in a growing, prosperous urban area became an incentive for change.

In addition, reduced water flow was preventing the expansion of rice farming along the lower Vermilion River, primarily in Vermilion Parish. Rice had become a mainstay for Acadiana agriculture once rail connections to New Orleans and Houston were available and its production increased rapidly. "By 1886, Southern Pacific was shipping two million pounds of rice from Acadiana to New Orleans. Six years later those shipments had grown to 200 million pounds" (Bradshaw 1997a).

Historically, rice emerged in south central Louisiana because of the low-lying rich alluvial soils and the plentiful water supply available from local bayous.

> Irrigation canals began to open the prairies to rice cultivation just about the turn of the century. One of the larger systems was that built by William Hawkins Hunter, who began acquiring land in the spring of 1898.
>
> He started digging on Bayou Vermilion about 10 miles north of Abbeville. The canal was dug 10 miles west from Milton, then 5 miles south, and again 5 miles west, making 20 miles of main canal, 200 feet wide and 8 feet deep. Lateral canals were dug from the main canal for many years, until the system eventually included some 400 miles of major and minor channels (Bradshaw 1997b).

Pumping out of the bayou was always the strategy for rice production in Vermilion parish and a network of canals gradually emerged to supply Vermilion River water to rice growers in the parish. To facilitate this, the Main Canal was dug as a private venture and the water was supplied (via a pumping station on the Vermilion River) to rice farmers in return for one fifth of their annual crop.

Plentiful water is a critical element in rice production. Rice crops are flooded after germination in the spring, drained for harvest in mid-season and flooded again as a second crop is produced from the stubble in the fall. In addition, increasingly, farmers flood once again after fall harvest to produce a crop of crayfish which feed on the remaining stubble. Not only is water needed for initial flooding, but also throughout the year because of high evaporation rates. Given the volume of water needed for these activities – a 100 acre field flooded three times to a six inch level would require 4,887,432 gallons for these initial floodings only – wells, because of their initial, and operating costs, were not an option.

Figure 2.2: Rice Fields, Vermilion Parish

The type of rice grown in southern Louisiana is very salt intolerant. By the 1950s because of the volume of water use, salt water intrusion was becoming a problem for some of the rice growers in southern Vermilion Parish. Today, while the Main Canal is no longer in operation, a network of gravity-flow canals branching off the Banker and Abbeville Canals (which connect to the Vermilion River) supply water to rice growers in the parish.

2.2 The Teche Vermilion Project

In 1952, the Louisiana Legislature passed Act 557 which directed the Department of Public Works to investigate the water supply problems in Southwest Louisiana (Kirkpatrick 1961). In 1954 the Department of Public Works produced the report of its investigation and followed up with recommendations. The Teche-Vermilion basin was experiencing surface water problems that, according to the findings, fell into three basic categories: 1) salt water intrusion, which was seen as primarily a problem for rice farmers in Vermilion Parish; 2) pollution, agricultural runoff, sewage treatment discharge; and 3) general water "deficiencies" in terms of quantity.

The report's recommendation was the diversion of water to the problem areas by way of a pumping station that would pump a certain amount of water from the Atchafalaya River to certain distributaries to correct the problem between the surface water requirements of the basin and the stream flow that is available. The Teche-Vermilion Water Diversion Project was submitted for proposal, in the form of a bill, for legislation on May 8, 1961, by Claude Kirkpatrick, the Director of the State of Louisiana Department of Public Works. By 1970 the plan, as presented in a tax milage referendum on four Parish ballots, was for approval of the currently existing system.

As it currently functions the Atchafalaya Pump station is located on the levee of the Atchafalaya River just north of Krotz Springs. The station uses up to four of its five pumps at a time, which delivers up to a combined (4 pumps) total of 1,000 cfs. The water flows west through a system of canals and inverted siphons under levees and other canals and bayous, crossing the western Atchafalaya Spillway and exiting the Atchafalaya Basin into Bayou Courtableau. Bayou Courtableau is maintained at an 18' level with a weir which ensures water flow westerly into the upper reaches of Bayou Teche where Courtableau intersects it at Port Barre. At Port Barre the water flows south in the Teche until reaching Arnaudville where some of the flow travels down Bayou Fusilier into the headwaters of the Vermillion River. That portion of the flow that remained in the Teche flows southeasterly to the Ruth Canal at Breaux Bridge where more water is diverted to the Vermilion River. The remainder of the flow continues down the Teche over the Keystone lock and dam to Baldwin and then south through the Charenton Canal to West Cote Blanche Bay and the Gulf of Mexico.

The Vermilion River flows south from its headwaters at the junction of Bayou Fusilier and Bayou Carencro through Lafayette to Abbeville. South of Abbeville some of the water is diverted through the Abbeville Canal to the west and north through an extensive system of canals and ditches which have been built up by local efforts over a century or more. The water that is not diverted at Perry continues southward about a third of the distance to the Gulf of Mexico to Banker and through the Banker Canal to another complex network of canals and ditches that also emerged over the course of a century or more. The remainder flows to the Gulf of Mexico by travelling past Intracoastal City and then through a dredged canal to Vermilion Bay.

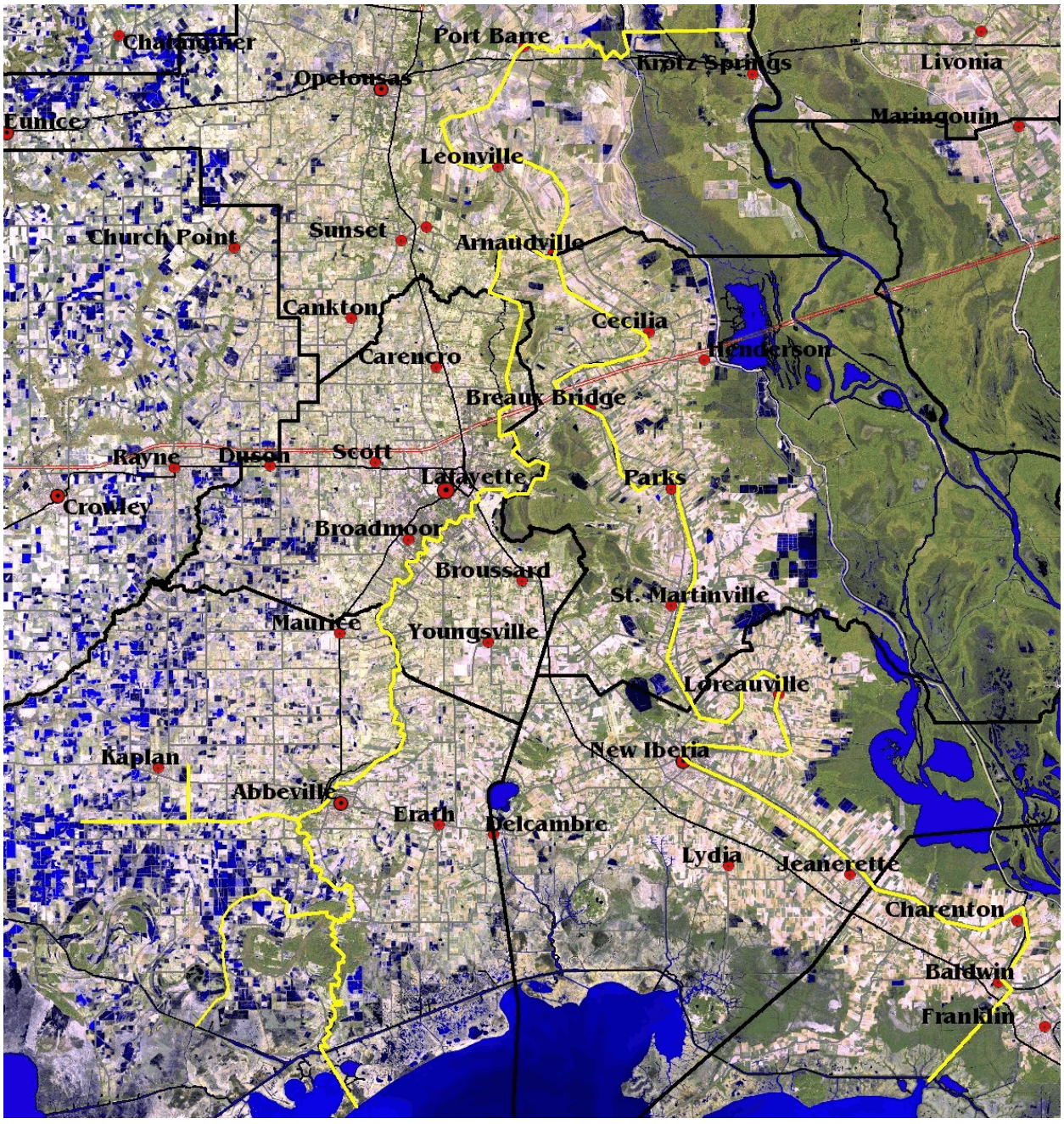

Figure 2.3: The Teche/Vermilion Diversion Project

Four Parishes (Lafayette, St Martin, Iberia and Vermilion) repeatedly voted to tax property owners to help pay for the project. In 1980 the vote to continue the project was over two thirds favorable in all four Parishes. It is noteworthy that no ballot measure appeared in St Landry Parish or in St Mary Parish. St Landry Parish hosts the headwaters (as it were) of the Teche

Vermilion Project; from the pump station to Port Barre and from there south to Arnaudville, where much of the water leaves the Teche to travel Bayou Fusilier on its way to the Vermilion. St. Mary Parish hosts the extra flow from several miles upstream of Baldwin to the open water of West Cote Bay.

Figure 2.4: Teche/Vermilion Pumping Station

Table 2.1 shows the annual volume total for the pumping station for the Teche Vermilion Project.

Table 2.1: Teche/Vermilion Annual Volume

Teche Vermilion Annual Pumping				
Year	Days pumped	Gallons	Acre feet	% Capacity*
1983	92	35,313,400,000	105,000	14.5
1984	108	45,589,300,000	135,000	18.6
1985	121	52,373,800,000	155,000	21.4
1986	191	71,854,000,000	213,000	29.4
1987	166	88,754,200,000	264,000	36.5
1988	154	65,335,200,000	194,000	26.8
1989	155	72,550,800,000	216,000	29.8
1990	213	124,475,400,000	370,000	51.1
1991	114	44,259,600,000	131,000	18.1
1992	139	64,718,500,000	192,000	26.5
1993	158	91,658,200,000	278,000	38.4
1994	126	81,716,600,000	243,000	33.6
1995	153	94,367,000,000	280,000	38.7
1996	220	123,014,700,000	366,000	50.6
1997	184	114,111,100,000	339,000	46.8
1998	225	154,152,000,000	458,000	63.3
1999	263	177,902,900,000	535,000	73.9
2000	306	173,057,000,000	524,000	72.4
2001	186	103,051,000,000	308,000	42.5
2002	164	88,642,000,000	268,000	37.0

* Total annual capacity = 723,967 Acre Feet

2.3 Findings

A number of conclusions can be drawn concerning the Teche/Vermilion project:

1. Informants[1] indicate that in general there is an overwhelmingly positive assessment of the project over its 23 years of operation. The most positive assessments generally involve:

A. Improved water quality on the Vermilion and Teche was noted by most respondents, although this is frequently expressed as the absence of undesirable qualities (odor, dead fish, black color, etc.) that were associated with the waterways before the project. Several individuals indicated that the improved water quality had resulted in an increase in property values on property contiguous to the waterways.

[1] Approximately 20-25 informants were interviewed along Bayou Teche and the Vermilion River. They ranged from mayors, to bank side residents, to rice farmers.

B. Rice and crawfish farmers in lower Lafayette and Vermilion parishes are very positive about the additional water. One farmer in lower Vermilion Parish – where saltwater intrusion was becoming a problem in the early 1970s – told us "I wouldn't be in business today" without the project.

2. Three negative, generally localized, effects were reported by informants:

A. A number of residents who live along the banks of Bayou Courtableau complained about bank erosion. Like most streams Bayou Courtableau fluctuated seasonally and with local rains prior to the Teche/Vermilion Project. The Teche/Vermilion Project maintains the Bayou at a constant (high) level for much of the year and this according to residents exacerbates the bank erosion. Boat traffic and associated wakes contribute to this problem.

B. Several respondents indicated that siltation on Bayou Teche in St. Martinville had increased in recent years. The Keystone Lock and Dam are on the Teche approximately two miles south of St. Martinville. The Keystone Dam is an overflow dam designed to raise the upstream water level, originally for navigation purposes. This effectively places St. Martinville in the "pool" of the dam. While all dam pools are subject to siltation, apparently the increased flow of silt laden water from the Atchafalaya River has exacerbated this problem at this location.

C. Several respondents complained about increased barge traffic on the Vermilion River following the Teche/Vermilion project. Given that barge traffic is confined to the lower part on the river – below Lafayette – where the river volume is sufficient for barge traffic, it is unlikely that an additional 1,000 cfs would affect the volume of the river enough to increase barge traffic.

2.4 Important Factors

1. The Teche/Vermilion project was locally initiated, in response to locally perceived needs.

2. There were clear, agreed on goals, to decrease pollution, salt water intrusion, and general water "deficiencies, " primarily for improvements to rice production.

3. The environmental changes were modest (1,000 cfs into headwaters of drainage basin), were distributed across two streams (Bayou Teche and the Vermilion River) and did not alter salinity of either basin.

4. The project has operated at 14.5% (1983) - 73.9% (1999) of capacity. This operation capacity has been controlled by a very simple metric, the pumps run when Bayou Courtableau is at less than18 feet at the weir gaging station.

3.0 Caernarvon

3.1 Background

For the purposes of this report the physical aspects of Caernarvon are less important than those of the Teche/Vermilion project and the Wax Lake Outlet. The Teche/Vermilion project has many similarities with the proposed Bayou Lafourche project, including diversion strategy and project dimensions. Likewise, the Wax Lake Outlet is the only project with a flow capacity that approximates the proposed TDCC. Caernarvon operates on gravity and hydrostatic pressure from the Mississippi River like the TDCC would and unlike the Bayou Lafourche project which would involve a pumping station. However, Caernarvon has a flow rate more like the proposed Bayou Lafourche project (see Table 3.1). Unlike either Bayou Lafourche or the TDCC Caernarvon has a very short conveyance channel going almost immediately from the control structure to the coastal wetlands (see Figures 3.1 and 3.2).

Table 3.1: Caernarvon Volume

Year	Days Open	Average cfs*	% Capacity
1992	92	200	3%
1993	230	1,016	13%
1994	295	1,858	23%
1995	272	1,652	21%
1996	311	1,998	25%
1997	103	2,989	37%
1998	269	1,560	20%
1999	203	1,409	18%
2000	208	1,889	24%
2001	262	1,565	20%
2002	249	1,555	19%
2003	172	2,069	26%
2004	213	2,183	27%
2005	182	1,859	23%
2006	192	2,569	32%

* When Open

What Caernarvon can instruct us about, more than any other existing project, is the way in which a complex restoration project can involve various stakeholder groups in a extended legal confrontation. The Caernarvon case went as far as the Louisiana Supreme Court, which reached a decision in 2004. For future restoration projects, but for this report particularly for the proposed TDCC (because of its potential for future litigation), it is important to understand what the denial of compensation to the plaintiffs was based on, what the court implied in its decision and what legal changes came about as a result of the legal battle in general.

An excellent summary of the history of the Mississippi water diversion at Caernarvon is given in the ruling of the Supreme Court of the State of Louisiana in the Caernarvon case – Avenal *v.* Louisiana. The "Facts and Procedural History" given by the court are concise, and easily understood. Segments of this decision will be used here to provide a preview into the political/legal issues to be discussed below.

As the court notes subsequent to the 1927 flood on the Mississippi River (see Barry 1997 for the most extensive review) the U.S. Army Corps of Engineers (Corps) constructed extensive additions to the Mississippi River levee system to prevent future major floods. Before this

construction naturally occurring floods deposited sediments into the coastal wetland on a regular basis. Without these nutrient-rich sediments, over time, the coastal wetlands were eroding, subsiding, and turning into open water at an estimated rate of between thirty-five and

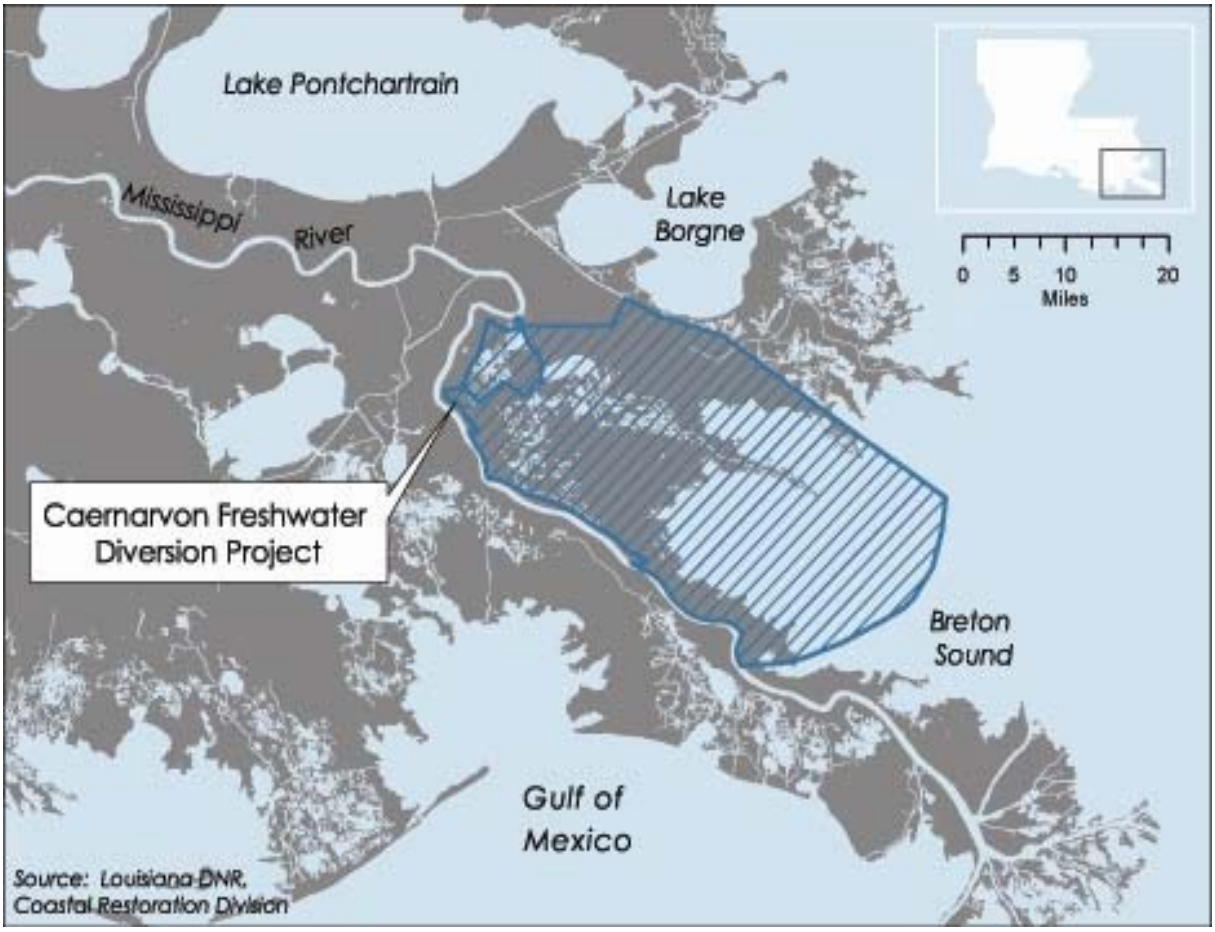

Figure 3.1: Affected area.

forty-five square miles a year. Specifically with regard to the oysters:

> Another effect of the levee system was on the salinity of the water. The coastal waters of Louisiana have historically provided excellent conditions for oyster growth, because the freshwater from the Mississippi River and smaller coastal streams mix with the saltwater of the Gulf of Mexico, creating an ideal ecosystem for oyster cultivation. By keeping fresh water out of the wetlands that surrounded the Mississippi River in the Breton Sound Basin, the levees unexpectedly raised the salinity of the waters covering those wetlands and this change in salinity fostered new oyster growth in the landward region of the basin that had previously been too fresh to sustain oyster growth. However, the changes in salinity that made some previously unproductive waters productive also ruined some oyster grounds that had been extremely productive before the levees were created.

3.2 The Caernarvon Project

> These effects were recognized in the 1950s, and the state and federal governments began planning to divert freshwater from the Mississippi River into adjacent marshlands to address these problems. According to a 1959 memorandum issued by the U.S. Fish and Wildlife Service to the Corps, certain man-made and natural causes, over time, had increased the salinity level of the sub-delta marshlands below New Orleans, thereby adversely affecting fish and wildlife, including oysters, waterfowl, and fur animals. This investigation was prompted, in part, by requests from local groups, including the oyster industry, which attended a public hearing in New Orleans on April 25, **1955**, concerning the need for freshwater diversions. After finding "a marked reduction [in oyster yield] per unit area" over time, the U.S. Fish and Wildlife Service concluded in the 1959 memorandum that "[i]ntroduction of fresh water to reestablish natural patterns of salinity and alluviation and increase fertility would provide the most effective method of restoring fish and wildlife production." [emphasis added]

The 1959 memorandum identified four areas in Plaquemines Parish as potential freshwater diversion sites, one of which was Caernarvon. In meetings in 1968 and 1969 with local interests – including the Louisiana Department of Wildlife and Fisheries (DWF) and the Plaquemines Parish Commission Council – the Corps proposed Caernarvon as the site of a freshwater diversion to be located on the east side of the Mississippi.

> The 1959 memorandum described the entire area... as "usually too fresh to support an oyster industry . . ." The memorandum stated that the pollution resulting from Caernarvon's discharge of silt would "not be a problem... as in other areas because an oyster fishery is not present." Thus, the 1959 memorandum confirmed that... [the area] where Caernarvon would alter salinity levels in the water, coincided with the area of Breton Sound Basin that had been shown to be outside the productive oyster zone as of 1960.
>
> During the 1970s, as land continued to erode and disappear further and further inshore, the zone favorable for oyster growth continued to move landward, due to saline changes. This landward salinity movement spawned an oyster community in the marshlands in the northwest portion of the Breton Sound Basin, which had previously been too fresh to sustain such growth. While creating new oyster grounds, the inland movement of salinity had the deleterious effect of rendering unusable large areas of previously productive oyster grounds, including the public seed grounds... On January 21, 1982, the State submitted a letter to the Corps, announcing its intent to participate in the Caernarvon project, and the Corps and the Louisiana Department of Natural Resources (the "DNR") issued a joint public notice about the project.

The Corps prepared an environmental impact statement in 1984, noting that the Caernarvon project was designed to combat saltwater intrusion, promote coastal restoration and enhance fisheries and wildlife in the basin.

The DNR and DWF set optimal target salinity zones in Breton Sound, which ranged from 5 parts per thousand ("ppt") for the northwest inland area of the basin to 15 ppt for the lower seaward end of the basin. The salinity zones were based upon the fact that below 5 ppt, oysters become stressed and die, while above 15 ppt, oysters are subject to saltwater predators and disease.

On October 30, 1986, Congress authorized the funds for construction of Caernarvon, and the State entered into a formal cooperation agreement with the Corps on June 10, 1987. The agreement recognized Caernarvon as one of the four sites originally authorized by the Flood Control Act of 1965. **In anticipation of the operation of Caernarvon, in 1989, DWF inserted a clause in its lease form, requiring that the State be indemnified and held harmless for any claims related to coastal restoration.** [emphasis added]

Also, in response to an October 26, 1990, letter from Bill Good, Ph.D., acting administrator of DNR's Coastal Restoration Division and chairman of the Caernarvon Interagency Advisory Committee (the "CIAC"), to the acting secretary of the DWF, that oyster leases within the Caernarvon structure's intended impact area might be adversely affected by the freshwater diversion flow, the DWF implemented an oyster "relay" operation. The relay, known as the Caernarvon Oyster Transfer, allowed oyster lessees with productive oyster leases, who obtained a relay permit and posted a $1,000.00 performance bond, to move their oysters from the potential Caernarvon impact area to predesignated lease sites outside the impact zone. Some lessees chose to participate, while others did not.

Construction commenced at the Caernarvon site on June 7, 1988, and was completed in February 1991. The official Caernarvon dedication was held on April 12, 1991... Caernarvon became operational in September of 1991 in accordance with the recommended flow rates, and this achieved some, but not all of the intended effects of the project. As a result, the CIAC eventually voted to significantly increase the flows of the Caernarvon project in 1993, resulting in a greater freshening of Breton Sound. While this greatly improved oyster production on the public seed grounds,... it reduced the salinity of the water covering the private oyster leases north of the public seed grounds and closer to the structure, where plaintiffs' leases are located. In 1996, the CIAC voted to decrease the flow to the original flow regime and has since monitored conditions, increasing or decreasing the flow in order to keep the annual average salinity within the 5 ppt target area or isohaline (area of equal salinity concentration).

3.3 The Historic Suit

On March 29, 1994, plaintiffs filed the instant class action suit on behalf of all persons holding oyster leases on state-owned water bottoms in Breton Sound, asserting that their oyster leases were destroyed or damaged because of the intrusion of freshwater from the Mississippi River by the Caernarvon project.

> The plaintiffs' oyster leases are located in Breton Sound, east of Caernarvon and west of the public seed grounds; further east of the public seed grounds is the Gulf of Mexico... Plaintiffs asserted that the State's action of lowering the salinity levels of the water in Breton Sound below that necessary to support oyster cultivation "has resulted in a permanent and substantial interference with plaintiffs' use and enjoyment of their land amounting to a taking of an interest in [their] property rights without compensation in violation of Article I, § 4 of the Louisiana Constitution . . ." Plaintiffs asserted that prior to the time Caernarvon went on line, the 5-15 ppt salinity range coexisted with their leases.
>
> On April 24, 1994, plaintiffs also filed suit in the United States Court of Federal Claims against the United States, more particularly the Corps, which designed, financed, and built Caernarvon, alleging the same takings theories, but under the Fifth Amendment to the United States Constitution. The Court of Federal Claims granted the Corps' motion for summary judgment in August of 1995, concluding that plaintiffs had no compensable expectancy in the continued artificially elevated saline levels caused by the Mississippi River levee system in historically freshwater marsh areas within Breton Sound. ***Avenal v. United States***, 33 Fed. Cl. 778 (1995). The court of appeal affirmed the decision on different grounds,... holding that the oyster lessees could not have had "reasonable investment-backed expectations" that their oyster leases would give them rights protected from the planned freshwater diversions authorized by the federal and state governments. ***Avenal v. United States,*** 100 F.3d 933 (Fed. Cir. 1996).

Ultimately the Louisiana Supreme Court ruled that because of indemnity clauses in the oyster leases held by most of the plaintiffs, which they signed, they had waived their right to sue. As for the remaining few plaintiffs who signed no such indemnity clauses, they had filed suit after the statutes of limitation had expired. Thus, there was no award to any of the plaintiffs.

While the supreme court ruled on the indemnity and statutes of limitation issues also in the ruling, the federal ruling indicated that the plaintiffs would have had no standing even if these two issues had not existed. The courts contended that the leases only pertained to the use of water bottoms, did not in any way guarantee either that oysters would be present, or that the water column would be maintained in such a manner as to facilitate oyster production and that since the state owned the water bottom and by law could not sell it, the state could not be "taking" something that it already owned. Finally, it was noted that the state was expected to act for the greater good of maintaining its wetlands over the narrower property rights of a few.

3.4 Amendment to the Louisiana State Constitution

In 2003 the Louisiana State Legislature inserted paragraph F Article 1 section 4 of the state constitution, thus, modifying section 4 to read:

§4. Right to Property

Section 4.(A) Every person has the right to acquire, own, control, use, enjoy, protect, and dispose of private property. This right is subject to reasonable statutory restrictions and the reasonable exercise of the police power.

(B) Property shall not be taken or damaged by the state or its political subdivisions except for public purposes and with just compensation paid to the owner or into court for his benefit. Property shall not be taken or damaged by any private entity authorized by law to expropriate, except for a public and necessary purpose and with just compensation paid to the owner; in such proceedings, whether the purpose is public and necessary shall be a judicial question. In every expropriation, a party has the right to trial by jury to determine compensation, and the owner shall be compensated to the full extent of his loss. No business enterprise or any of its assets shall be taken for the purpose of operating that enterprise or halting competition with a government enterprise. However, a municipality may expropriate a utility within its jurisdiction.

(C) Personal effects, other than contraband, shall never be taken.

(D) But the following property may be forfeited and disposed of in a civil proceeding, as provided by law: contraband drugs; property derived in whole or in part from contraband drugs; property used in the distribution, transfer, sale, felony possession, manufacture, or transportation of contraband drugs; property furnished or intended to be furnished in exchange for contraband drugs; property used or intended to be used to facilitate any of the above conduct; or other property because the above-described property has been rendered unavailable.

(E) This Section shall not apply to appropriation of property necessary for levee and levee drainage purposes.

(F) Further, the legislature may place limitations on the extent of recovery for the taking of, or loss or damage to, property rights affected by coastal wetlands conservation, management, preservation, enhancement, creation, or restoration activities. [emphasis added]

The amendment was approved by popular vote later that year.

3.5 Findings

Actual operation of the Caernarvon project has been less than optimal for marsh restoration due to the changes in overall basin management objectives resulting from sociopolitical

Figure 3.2: The Diversion Structure at Caernarvon (Mississippi River in foreground)

factors and litigation. Flows have also been reduced out of concern over freshening the water adjacent to the outflow.

But, even at these reduced flow rates, Caernarvon has succeeded at increasing marsh acreage in the areas adjacent to the outflow.

Caernarvon was conceived as a way to restore portions of an ecosystem by attempting to reverse effects of previous ecosystem alterations, including the installation of the levee system on the Mississippi River.

One of the primary motivations for the entire Caernarvon project was to freshen up the water in the State's oyster seed beds. But further, the plan relied heavily upon changing the salinity of a large area to effect coastal restoration generally - actually build land, and to change the area back to an earlier fresher ecosystem with a completely different mix of flora and fauna. Almost all of this was to be accomplished by means of salinity manipulation.

The plan was primarily successful, judging by the actual measured results. But sweeping plans for sweeping changes have sweeping social impacts. As Caernarvon demonstrated projects that do not take human usage fully into account can have significant unintended consequence, including a protracted legal battle and the construction of projects that are not allowed, because of social considerations, to function at their full restoration potential.

The takings issues raised in Avenal *v.* Louisiana are not likely to causes as many difficulties in the future because the constitution has been amended so as to place reasonable limits on awards in takings issues.

4.0 Wax Lake Outlet

4.1 Introduction

While the Wax Lake Outlet was originally designed as a flood control measure, it has become the classic example of a sediment diversion success story. The outlet was dug through the natural levees of Bayou Teche in 1942 as a U.S. Army Corps of Engineer's project. Since the Wax Lake Outlet is a shorter and more hydraulically preferable route to the Gulf, it began to capture more and more of the flow from the main channel of the Atchafalaya River. In an attempt to prevent this and to maintain a flow in the Atchafalaya River sufficient to alleviate siltation during periods of low water, a control weir was built by the Corps in 1988 above the Wax Lake Outlet in Six Mile Lake. Siltation had become a problem for oil related businesses located along the Patterson to Amelia strip of the Teche Ridge, that used the Atchafalaya River as their access to the Gulf. However, during periods of high water the weir was blamed for flooding some of those same businesses and was removed in 1994. The removed rocks were used as breakwaters at Grand Isle. The outlet has scoured to become a major distributary of the Atchafalaya River, at peak flow carrying over 200,000 cfs. The flow of Red and Mississippi River water through the Atchafalaya River and the Wax Lake Outlet into the shallow waters of Atchafalaya Bay has resulted in sediment deposition and land formation, in the form of new deltas.

The Wax Lake Outlet and Delta is viewed as a design analog for the TDCC. The Wax Lake Delta has received extensive attention from the coastal restoration community because it is the only natural delta currently being built by the Mississippi River. Both the Atchafalaya Delta and the main Mississippi River Delta are influenced by maintained navigation channels, whereas the Wax Lake Delta is not (cf. van Heerden et al. 1983).

4.2 Issues

For the purposes of this report there are several important points that need to be made.

1. The Wax Lake – and Atchafalaya River – Delta clearly demonstrated that the basic hydrological and geological principles associated with river delta formation still work and that any way that large portions of a sediment rich river – such as the Mississippi – can be dumped onto a shallow continental shelf – such as is found off the southern and extreme eastern coastline of Louisiana – or estuary will produce delta building and wetland formation. It is probably safe to say that the more the volume the more and faster the formation. Since the sediment load of even the Mississippi River is not infinite, the issue becomes not if, but where?

2. The Wax Lake Delta is approximately 12,000 acres of land and the Atchafalaya River Delta is approximately 15,000 acres (Louisiana Wildlife and Fisheries 2006).

3. The Wax Lake Outlet was dug in 1942 through a largely uninhabited portion of the Atchafalaya Basin, decades before environmental protection legislation – primarily the National Environmental Protection Act (NEPA) of 1969 – were enacted. Whether a

project of this magnitude could be done, with NEPA and in a more populated area, is questionable.

Figure 4.1: Wax Lake Outlet

4. The Wax Lake Outlet flows from Six Mile Lake in the Atchafalaya Basin a distance of approximately 14.5 miles to the Atchafalaya Bay (see Figure 4.1).

5.0 Survey

5.1 Rationale

Residents of the Bayou Lafourche region have more at stake when considering the two projects proposed for their area of south Louisiana. They face the possibility of increased risk due to the potential effects from diversion projects installation and operation, a "no action" approach and the results of continuing future coastal land loss, or both. To determine the knowledge held by residents and their opinions concerning the Bayou Lafourche project and the Third Delta project we developed and administered a mail questionnaire.

5.2 Methods

In order to construct the survey instrument we accessed sources that were available to area residents interested in learning about the projects. These sources included local newspapers from the Bayou Lafourche region, Department of Natural Resources website and reports, technical reports from engineering firms, newsletters from regional restoration proponents and internet websites. Consulting these documents we constructed questions that addressed the details of the projects. The three page questionnaire asked if residents had heard about the proposed projects, where they heard about the projects, their level of familiarity with the projects, knowledge of the specific goals and design of the projects, if the respondents favor or oppose the projects, and why they favored or opposed the projects. Demographic questions asked about location, gender, race, age, education, income and occupation. Most of the questions were closed-ended in format providing respondents with a check box for their response. Questions requiring an explanation were open-ended. Respondents were asked to provide contact information if they were willing to participate further in the survey.

5.2.1 Sample

The DeLorme Street Atlas USA 2006 Plus containing contact information for residents allowed us to search for names and addresses based on zip codes. Zip codes for all geographic areas adjacent to Bayou Lafourche, from Donaldsonville to Leeville were determined. All names and addresses within these zip codes were assembled into a list which was used as our sampling frame. From the sampling frame we randomly selected 5000 residents for the sample.

5.2.2 Mail out

Using the inexpensive bulk mailing option, we mailed 5000 questionnaires. Bulk mail is not returned to the sender if undeliverable so we are not able to estimate how many questionnaires actually reached the recipient. Postcards were sent by bulk mail to all 5000 addresses two weeks after the original questionnaire was mailed. The postcard served three purposes: 1) it acted as a thank you note for those who had already completed and returned the questionnaire; 2) it served as a reminder to those who had not yet mailed in the questionnaire to please do so; and 3) it informed residents that they could request another questionnaire. Respondents returned 287 completed questionnaires.

5.2.3 Analysis

The personal characteristics and location of the survey respondents are as follows. The majority of the respondents are male (74%), 24% are high school graduates or the equivalent, 25% attended some college or technical school, 29% have a college or technical school diploma, and 17% have a professional degree. Caucasians represent the vast majority of respondents (88%), while Blacks, Native Americans, Asians, and Hispanics make up approximately 7 percent. The average income of respondents is $65333 per year, with only 2 percent of the respondents earning less than $11000 per year, and 8 percent earning more than $100,000 per year. The areas of Thibodaux (35%), Raceland (12%) and Cut off (10.5%) had the greatest number of respondents. For the analysis a new location variable was created based on proximity to Thibodaux, with those living in Thibodaux and to the north of Thibodaux comprising one group (n=149; 57%), and those living to the south of Thibodaux the other group (n=114; 43%).

The following analysis is a summary of the detailed analysis. For a full explanation of the findings, see Appendices A and B.

5.3 Summary : The Bayou Lafourche Water Diversion Project

The majority of respondents have heard about the Bayou Lafourche project and favor it's implementation, but familiarity with the project's goals, impacts, and construction vary considerably. Respondents are familiar with the goal of the project to increase the flow of water in the bayou in order to improve its quality as a source of drinking water to area residents. Most understand the project to be a coastal restoration project that will benefit marshes and coastal habitat through increased creation and protection. Respondents think the project will not increase salt water intrusion to the bayou and surrounding areas. Although many do not think it will increase flooding to the region, a substantial number acknowledge that they do not know if it will or not. Respondents are mixed concerning their understanding of the possible environmental effects of the project, including if and how it will change fisheries in the region. They are more likely to report that they think the project will cause waters in the bays to be fresher, as opposed too muddier, but many are not sure. They think it is more likely that the project will increase recreational opportunities rather than promote tourism in the area. Respondents are even less familiar with the projects construction and implementation needs. Most are not sure if dredging will be necessary, if bridges will need to be replaced, or if it will be necessary to relocate oil and gas pipelines. They are equally unclear on what will be needed to maintain the increased flow of water into the bayou for example, the need for pumping and monitoring stations or the construction of bulkheads.

Respondents report having heard about the Bayou Lafourche project from a number of sources. Those in favor of the project report hearing about it from: 1) Media; 2) Area residents; 3) Organizational and community meetings; 4) The Corps of Engineers and Department of Natural Resources; 5) Libraries; and 6) Internet. Respondents opposed to the Bayou Lafourche project report hearing about it from: 1) Media; 2) Area residents; 3) Organizational and community meetings; 4) Engineers and studies. Respondents who neither favor nor oppose the Bayou Lafourche project report hearing about it from: 1) This research questionnaire; 2) Media; 3) Area residents; and 4) a public meeting.

Familiarity does not necessarily increase a respondent's likelihood of favoring the Bayou Lafourche project. Those who are familiar with the project tend to favor the project slightly more than those who know nothing about it. What they think about the project seems to be the most important factor when reaching a decision to favor or oppose the project. If respondents think it will create coastal habitat, protect coastal habitat, supply a source of fresh drinking water, create fresher bays, create more recreational opportunities, and promote tourism, while not increasing salt water intrusion, not causing flooding, not changing fisheries, not requiring bulkheads or the relocation of gas and oil pipelines or the replacement of bridges then they are most likely in favor of the project.

When asked why they favored or opposed the Bayou Lafourche project respondents offered an assortment of answers. The reasons given for being in favor of the Bayou Lafourche project are: 1) Coastal restoration; 2) Improvements to Bayou Lafourche; 3) Stopping salt water intrusion; 4) Ecological and environmental improvements; 5) Recreational improvements; and 6) Efficiency. The reasons given by respondents for being opposed to the Bayou Lafourche project are: 1) Flooding; 2) Loss of property; 3) Costs; 4) Pollution; and 5) It won't work. The reason given for being neither in favor of or opposed to the Bayou Lafourche project is that they don't know enough about the project to have an opinion.

According to respondents who favor the Bayou Lafourche project the most important things we should know about the project are: 1) Restorative prospects; 2) Impacts/Effects; 3) It's a necessity; 4) Risks versus benefits; 5) Costs; and 6) Time frame. According to respondents who oppose the Bayou Lafourche project the most important things we should know about the project are: 1) Flooding possibilities; 2) Erosion of property; 3) Costs outweigh benefits; 4) It won't work; 5) Political project; 6) Not a restoration project.

The respondent's location on the northern or southern portion of the bayou helps to explain their understanding of the project and their opinion of its implementation. Those located in the northern region are more likely to acknowledge the possible negative outcomes associated with the project, including increased salt water intrusion, the potential for flooding, the erosion of bayou side property, failure to protect marsh habitat or improve the quality of the drinking water or the freshness of the water in the bays. The respondents residing on the southern region of the bayou are less likely to think that these outcomes will occur.

Both males and females favor the implementation of the Bayou Lafourche project. The respondent's gender made a difference in if they have heard about the project and how familiar they are with the details of the project. Females are less likely to have heard about the project and tend to be less certain about the overall goals and impacts of the project, as well as construction and implementation processes associated with the project. Males, on the other hand are less likely to state that they are not sure about the details of the project. The majority of males think the project will create and protect coastal habitat, will provide a source of fresh drinking water, will benefit the marshes in Terrebonne and Barataria bays, will cause the water in the bays to be fresher, will create recreational opportunities, will promote tourism, and will not increase salt water intrusion while the majority of females are uncertain about all of these project details.

Respondents overwhelmingly favor the project if they view it as a project to create and benefit coastal marshes. These respondents want action to be taken as soon as possible and see the project as having mostly positive outcomes. Respondents who fear that the project will place them at greater risk for flooding or place bayou side property in jeopardy of eroding overwhelmingly oppose the project and are more likely to cite the cost as prohibitive. These respondents want guarantees that the risks can be minimized before supporting its implementation.

5.4 Summary: The Third Delta Conveyance Channel

The majority of respondents have not heard about the TDCC project, and those who have heard of it vary considerably in their familiarity with the details of the project. Of those respondents who have heard about the project, the majority of them favor its implementation. Respondents admit that they lack information about the project, but most recognize that it is intended as a coastal restoration project that will benefit te marshes in Terrebonne and Barataria bays, cause the bays' waters to be fresher and eventually create new deltas. They think it will be a source of drinking water and that it will likely change fisheries in the area. Most are uncertain of its design and implementation features.

Respondents report having heard about the TDCC project from a number of sources. Those in favor of the project report hearing about it from: 1) Media; 2) Area residents; 3) Organizational and community meetings; 4) This research questionnaire; 5) Internet; 6) The Corps of Engineers, other agencies, and Nicholls State University. Respondents opposed to the TDCC project report hearing about it from: 1) Media; 2) They haven't heard of it; 3) The street or hearsay; 4) Internet; 5) Meetings; 6) Department of Natural Resources, Restore or Retreat; and 7) Feasibility study. Respondents who neither favor nor oppose the Third Delta project report hearing about it from: 1) This research questionnaire; 2) Media; 3) Area residents; and 4) Meetings; and 5) The Army Corps of Engineers.

As most respondents are not familiar with the TDCC project, the variable is not a predictor of a respondents likelihood of favoring or opposing the project. If respondents think the project will create new deltas, create coastal habitat, protect coastal habitat, supply fresh drinking water, benefit the marshes, contribute fresher waters to bays, create recreational opportunities, and promote tourism, while not increasing salt water intrusion, not causing flooding, not eroding over time, not requiring the relocation of oil and gas pipelines and not crossing the path of the Bayou Lafourche, they are most likely in favor of the project.

The reasons given for being in favor of the TDCC project are: 1) Coastal restoration; 2) Stopping salt water intrusion; 3) Alleviate flooding; 4) Effectiveness; and 5) Necessity. The reasons given by respondents for being opposed to the TDCC project are: 1) Costs; 2) Inefficient; 3) Flooding; 4) Destructiveness, 5) Will turn into a shipping channel; and 6) It won't work. The reason given for being neither in favor of or opposed to the Third Delta project is that they don't know enough about the project to have an opinion.

According to respondents who favor the TDCC project the most important things we should know about the project are: 1) It's a necessity; 2) Restorative potential; 3) Flooding possibilities; 4) Effect on Bayou Lafourche project; 5) Impacts/Effects; 6) It's experimental;

7) Questions about construction and monitoring; 8) Costs; and 9) Needs additional study. According to respondents who oppose the TDCC project the most important things we should know about the project are: 1) Too destructive; 2) Too costly; 3) It's a gamble; 4) Flooding possibilities; 5) Monitoring; 6) Time frame; and 7) It should be stopped.

Respondents' location does influence how much they know about the project and whether they favor its implementation or not. Opposition to the project is more likely to come from respondents living in the northern region of the bayou. They question whether it will be successful in creating new deltas and they tend to focus on the destructiveness of the project to the environment, the high costs of implementing the project, and the slow return on investment as new deltas will not emerge for many years. Those living along the southern region of the bayou are more likely to think that the project will be successful at creating new deltas in the Barataria and Terrebonne Bays. They tend to stress the benefits that could result from the project and focus on the need to do something now rather than waiting.

Gender did factor into the analysis of the TDCC project. Males claim to be more familiar with the project, especially its goals and potential impacts. Females are less certain as to the goals of the project and its range of impacts. Overall males and females know little about the design and implementation of the project.

Respondents favor the project if they view it as a project to create and benefit coastal marshes while not destroying the environment. They want action to be taken as soon as possible and see the project as having mostly positive outcomes. Respondents who fear that the project will place them at greater risk for flooding or place existing wetlands in a position of eroding overwhelmingly oppose the project and are more likely to cite the costs to the environment as prohibitive. Before supporting such a project, these respondents want existing channels and canals to be used to create new deltas rather than digging new channels.

5.5 Similarities Between Projects

There are some overarching patterns between people's knowledge of and opinion concerning the two proposed projects. If respondents think the projects are aimed at coastal restoration and improving the marsh, wetlands, and barrier islands of south Louisiana, they tend to be in favor of their implementation. If respondents think the projects are going to benefit the people of the area, by improving the quality of the drinking water, by increasing opportunities for recreation and promoting tourism, and by potentially creating new commercial or industrial corridors that might lead to increased employment, they tend to be in favor of the projects.

On the other hand, if respondents think the projects are going to be disruptive to community life, through the possibility of flooding, the need to replace bridges, the construction of levees, impacts to roads and railroads, or having to relocate oil and gas pipelines, they are more likely to oppose the project. If respondents think the project will be destructive to the environment in its construction, by having to dredge the bayou or channels, installing pumping stations and monitoring stations, having the initial channel develop over time through an erosion process, or having it cross an existing waterway, they are more likely to oppose the project.

6.0 Mississippi River Water Reintroduction Into Bayou Lafourche.

6.1 Introduction

Bayou Lafourche historically was a natural distributary of the Mississippi and a major transportation route for goods and western migration prior to the Civil War – early estimates are that Bayou Lafourche carried roughly 12 percent (over 40,000 cubic feet per second) of Mississippi River flow. As settlement and agriculture grew along the natural levee of Bayou Lafourche, the annual flooding of the bayou increasingly became a problem. Pressure on the state legislature to address the problem grew and in 1904 a dam to cut off the bayou from the Mississippi River was completed.

6.2 The Problem

Although a lock connecting the bayou and the river was part of the original vision, the state never built the lock, closing much of the navigation on the bayou. This brute-force solution to the flooding created another problem. Because Bayou Lafourche no longer functioned as a distributary of the Mississippi River it became in essence a long stagnant lake. As Emmer et al. (2003 p. 9) note:

> When the WPA writers passed through in the late1930s and early 1940s, they described the bayou as a "stagnant waterway," with its "upper reaches covered with water hyacinths." By that time, the Mississippi River dam had caused disastrous results. The absence of river flow forced the government to dig canals at periodic points to pull freshwater from the swamps. This solution was problematic. In 1930, the potable water dilemma forced the city of Thibodaux to lay a 17-mile pipeline to draw water from the Mississippi River to its filter plant along Bayou Lafourche.

Damming the bayou also severed the route for sediment to the coastal marsh and contributed to the already rapid loss of wetlands in the lower Terrebonne and Barataria Basins. As a response to these problems, the Bayou Lafourche Freshwater District constructed a siphon and pump at Donaldsonville on the Mississippi Levee in 1955. Originally the pumping capacity was approximately 340 cubic feet per second (cfs), but the aging pumps today manage about 200 cfs. With population growth the bayou has become the source of drinking water for over 200,000 people, and a major source of potable water for use by the offshore oil and gas industry. In addition, numerous oil field canals, the Gulf Intracoastal Waterway (GIWW), and the Houma Navigation Canal have altered the natural hydrology of the area. This alteration has affected the freshwater flows to area marshes, and saltwater intrusion has impacted drinking water quality.

Figure 6.1: Pump Station at Donaldsonville

6.3 The Solution

At the simplest level, the proposed solution to the fresh water problem with Bayou Lafourche is to increase the pumping/siphon capacity into the headwaters of the bayou at, or near, Donaldsonville. Planning for the diversion started in the mid 1990s as a Louisiana Department of Natural Resources and Environmental Protection Agency project. The initial design envisioned a 2,000 cfs siphon, but local opposition slowed the planning process until more specificity about how the project would work was available.

Subsequent analysis (CH2MHILL 2005) laid out some fundamental questions related to the project. These were: 1) whether to reintroduce water at Donaldsonville or through a conveyance channel to Smoke Bend upstream from Donaldsonville; 2) if the Smoke Bend alternative is chosen what the configuration of the channel is; 3) if the Donaldsonville alternative is chosen how more flow can be passed through the Union pacific Railroad Bridge in Donaldsonville; 4) what the flow rate – from 1,000 - 2,000 cfs – will be; 5) what water level rise is acceptable in Donaldsonville; 6)what water level rise is acceptable in Thibodaux; 7) how deep the dredging of the Bayou Lafourche channel will be; and 8) what type of flow control structures will be utilized along Bayou Lafourche. The various interactions between these considerations resulted originally in 144 alternatives for the project and CH2MHILL (2005) reduced these to five for consideration in the next level of analysis.

While the project is still in the planning process as of this writing (2006), the latest draft analysis of the project engineering configuration by CH2MHILL (2006) considered the five alternatives plus one new "least rise" (least water rise in Bayou Lafourche) and reconsidered one that had been previously eliminated. The end result was the recommendation of one alternative (# 38) that would introduce water at Donaldsonville and replace the Union Pacific Railroad Bridge to facilitate water flow. This configuration was chosen as the most cost-effective alternative that could deliver 1,000 cfs without raising the water along Bayou Lafourche to unacceptable levels. The details of this configuration are outlined below.

6.4 Alternative #38 details:

Performance Criteria
Operational Flow = 970 cfs

Diversion Facilities
Intake Facilities

Forebay-type: Vertical sheetpile walls with tie-back system
Screening (trash/debris): Log boom (river side), Manually cleaned bar rack at pump intake

Pump Station

Initial Capacity: 1,000 cfs
Expandable Capacity: 1,500 cfs
Number of Pumps: 4
Pump Type: Axial Flow
Pump Horsepower (ea.): 700
Pump Control: 2 pumps – constant speed; 2 pumps – adjustable speed drives
Emergency Back-up Capability: Existing pump station has two pumps with auxiliary diesel motors for backup in case of electrical power outage (capacity = 170 cfs)
Facility length (feet): 140

Existing Pump Station

Initial Capacity: 340 cfs
Number of Pumps: 4
Pump Type: Axial Flow
Pump Horsepower (ea.): 250
Upgrades Proposed:
Vacuum system replacement
Refurbishment of 1 pump

Discharge Facilities

Discharge Piping Diameter (inches): 78
Discharge Piping Material: Steel
Number of Discharge Pipes (pre-expansion installation): 6
Discharge facility length (feet): 66

Sedimentation Basin

Location: RM 0.6 on Bayou Lafourche
Design settling velocity (fps): 0.02
Max. settling volume (annual cy): 5,600
Min. basin length (feet): 400

Conveyance Channel Improvements

Dredging

Dredge Template: 2-foot and 0-foot @ RM 29
Dredge Volume (cy): 2,900,000
Side-Slopes: 2.5H:1V
Bottom Widths (range, feet): 34 - 95
Final Disposition of Dredge Sediments (Assumptions)

45 percent in-water/marsh creation
45 percent upland containment areas
5 percent to Mississippi River
5 percent debris to landfill

Bridge Replacements/Modifications

Replace Union Pacific Railroad Bridge
Brace Bridges Hwy 998, Hwy 403, and Hwy 402

Control Structures

Number Assumed 3; Type: Inflatable bladder w/steel weir plate
Approximate location: Palo Alto Bridge, Napoleonville, Thibodaux
Demolition of Thibodaux weir

Monitoring Systems

Water Level: Continuous recorders, pressure transducers SCADA data system
Water Quality: Continuous probe type sensors (pH, conductivity, dissolved oxygen, redox, turbidity, total organic compounds) SCADA data system

In addition to these details, several assumptions must be made so that some issues can be taken off the table in order to facilitate assessment of impacts.

6.5 Assumptions

1. Initial construction impacts, dredging, disposal of dredge material, lowering of pipelines that cross the bayou (estimated at 40), construction of a new railroad bridge, accessing the bayou to accomplish these, the noise, traffic congestion, etc., all of initial construction mess associated with large projects will be temporary. As with any of the alternatives, number 38 will require some initial (less than most alternatives) and maintenance dredging. The construction of a sand trap – where the bayou becomes wider and deeper allowing sand to drop out of the water column – will facilitate and localize maintenance dredging. Figure 6.2 shows Bayou Lafourche immediately below the existing pumping station and it is obvious that dredging will be necessary to allow 1,000 cfs to pass this point.

Figure 6.2: Headwaters, Bayou Lafourche

2. While if, and how, the additional diversion water will be distributed into the wetlands above the Gulf Intracoastal Waterway (GIWW) has not been finalized, it is assumed that any such distribution will be beneficial.

3. Potential damages arising from diversions have been limited by the Louisiana Supreme Court decision Avenal *v*. Louisiana and the recent amendment to the Louisiana Constitution (see discussion under Caernarvon above).

4. The CH2MHILL (2005) report does not consider any channel modifications below Lockport. Figure 6.3 shows Bayou Lafourche at Lockport. The bayou is substantial at this point and navigable by relatively large vessels. Accordingly, we are assuming that an additional 1,000 cfs of fresh water will not have any negative effects below Lockport. Approximately 15 miles below Lockport Bayou Lafourche intersects the GIWW. The GIWW is a minimum 125' by 12' contour channel. An additional 1,000 cfs of fresh water will certainly have no negative effects below this point. Any additional freshwater diverted into the area below the GIWW will be beneficial.

Figure 6.3: Bayou Lafourche at Lockport

6.6 Permanent Intended Effects

1. The primary stated objective of the project is to nourish and protect the marshes of the Barataria and Terrebonne Basins through the reintroduction of freshwater, sediments, and nutrients from the Mississippi River while limiting saltwater intrusion.

2. Providing an increased water supply for human use is also an intended effect. With population growth the bayou has become the source of drinking water for over 200,000 people, and a major source of potable water for use by the offshore oil and gas industry. Ultimately the diverted waters would bring a better fresh water supply to all of the people and businesses along the Bayou all the way to Port Fourchon, a growing and important offshore supply port near the mouth of Bayou Lafourche. The freshwater intakes and delivery infrastructure are already in place. Approximately 40 cfs of water out of the bayou is currently used by local water systems (CH2MHILL 2005; Appendix B) and this is sure to grow.

3. Addressing saltwater intrusion, particularly between Lockport and the GIWW is a related and intended effect of the project. During periods of low water, salt water can reach the water

intake below Lockport, closing it. The additional 1,000 cfs of fresh water in the bayou should prevent this from happening.

4. Water quality in general in Bayou Lafourche has declined due to an increasing pollution load from sources such as septic tanks (many areas along the bayou are not sewered), urban runoff and agricultural (primarily sugar cane) runoff (EPA 1998). Additional freshwater will help address this issue.

5. The Environmental Protection Agency (EPA 1998) makes a strong case that wetland loss in the lower Bayou Lafourche area (Barataria and Terrebonne Basins) is connected to the closing of Bayou Lafourche as a distributary of the Mississippi River and further argues that:

> Opportunities to implement diversions along the coast are limited because of potential conflicts between the hydrologic changes caused by diversions, and the human activities impacted by those changes. For this reason, <u>any</u> diversion opportunity needs to be explored to determine if it can be implemented without causing significant cultural and economic disruption (EPA 1998:1.3-3).

However, whether a 1,000 cfs diversion can significantly affect an area that was originally created, and maintained, by an estimated 40,000 cfs diversion (the Bayou Lafourche that was noted by early explorers) has been questioned.

6.7 Permanent Additional Effects

Alternative 38 would cause the bayou to rise less than three feet, with the maximum rise (approaching three feet) occurring just below the location of the current weir at Thibodaux. However, the alternative calls for the removal of the current weir at Thibodaux and the installation of inflatable weirs at the Palo Alto Bridge, Napoleonville, and Thibodaux. These would be used to maintain water levels in the bayou for bank stability, primarily if the pumping station must be shut down. The pumping station would need to be shut down if there was a toxic spill on the Mississippi River. The weirs would also be used to stop flow down the bayou if a spill made it through the pumps.

1. A rise in Bayou Lafourche of approximately three feet would have impacts primarily on structures that have been build on the batture, or on fill placed on the batture and the submersion of portions of the batture. Figures 6.4 and 6.5 show the types of developments on the batture that will be impacted. While the structures shown in the figures are some of the more elaborate along the bayou, numerous docks, decks and patios will be affected. Most of these structures are on what is assumed to be publically owned property, but as the lesson of Caernarvon showed us, and as a relatively famous attorney told one of us, “the answer to the question ‘can I sue’ is always yes.” The number of structures and acres affected has been estimated by CH2MHILL (2006) and is shown in Table 6.1. The details of exactly how these “ownership” issues will play out is not known, but this should not be a project stopping issue.

2. The primary negative issue associated with the Teche/Vermilion Project (discussed above) was the increase in bank erosion along Bayou Courtableau. The Teche/Vermilion Project elevated the water level in Courtableau and maintained it at these higher levels. According to some respondents this led to increasing erosion levels. While bank stability issues have not been addressed to date – primarily because soil cores have not yet been taken – this is a potential future issue for the Bayou Lafourche project.

3. With elevated water levels on Bayou Courtableau and an improvement in water quality, boat traffic on the waterway increased, exacerbating erosion because of boat wakes. Since one of the stated objectives of the Bayou Lafourche project is to improve water quality on the bayou, increased traffic is to be expected.

Figure 6.4: Camp

Figure 6.5: Gazebo

6.8 Survey Findings

The majority of respondents have heard about the Bayou Lafourche project and favor it's implementation, but familiarity with the projects goals, impacts, and construction vary considerably. Respondents are familiar with the goal of the project to increase the flow of water in the bayou in order to improve it's quality as a source of drinking water to area residents. Most understand the project to be a coastal restoration project that will benefit marshes and coastal habitat through increased creation and protection. Respondents are less familiar with the projects construction and implementation needs. Most are not sure if dredging will be necessary, if bridges will need to be replaced, or if it will be necessary to relocate oil and gas pipelines. They are equally unclear on what will be needed to maintain the increased flow for example, the need for

Table 6.1: Structures and acreage affected by alternative 38

Reach	Structures	Docks	Acres
Donaldsonville to Palo Alto Bridge	7	0	7
Palo Alto Bridge to Thibodaux weir	91	81	94
Thibodaux weir to Lockport	30	156	66

pumping and monitoring stations or the construction of bulkheads.

The respondent's location on the northern or southern portion of the bayou helps to explain their understanding of the project and their opinion of it's implementation. Those located in the northern region are more likely to emphasize the possible negative outcomes associated with the project, including the potential for flooding, the erosion of bayou side property, failure to protect marsh habitat or improve the quality of the drinking water or the freshness of the water in the bays. The respondents residing on the southern region of the bayou tend to focus on the more positive aspects of the project.

The respondent's gender made a difference in if they have heard about the project and how familiar they are with the details of the project. Females are less likely to have heard about the project and tend to be less certain about the overall goals and impacts of the project, as well as construction and implementation processes associated with the project.

Respondents overwhelmingly favor the project if they view it as a project to create and benefit coastal marshes. These respondents want action to be taken as soon as possible and see the project as having mostly positive outcomes. Respondents who fear that the project will place them at greater risk for flooding or place bayou side property in jeopardy of eroding overwhelmingly oppose the project and are more likely to cite the cost as prohibitive. These respondents want guarantees that these risks can be minimized before supporting it's implementation.

6.9 Conclusion

The Mississippi River Water Reintroduction Into Bayou Lafourche project is a relatively straightforward one with the anticipation of few lasting social impacts. Those social impacts that are anticipated result from the elevation of the water level in the bayou. In the short term this will require the removal, alteration or loss of some structures, primarily those built on the batture. There is the possibility that elevated water levels, flow rates, and boat traffic could lead to increased erosion rates in some areas.

7.0 The Third Delta Conveyance Channel

7.1 Introduction

In 1993 Sherwood Gagliano and his associate Johannes van Beek (Gagliano and van Beek 1993; 1999) having been long concerned with the loss of Louisiana's coastal wetlands and having long studied the processes of erosion and subsidence (marsh loss) on the one hand and deposition (marsh building) on the other and having long studied the effects upon these natural processes caused by flood control efforts (impounding the Mississippi River between levees) and channel dredging and pipeline emplacement, developed a plan to mitigate marsh loss. Their ambitious design incorporates their understandings of the relevant natural processes and (theoretically) uses them to build back two large lobes of marshland in the Barataria and Terrebonne bays, where marsh loss has been the most extreme.

7.2 The Problem

Damming Bayou Lafourche severed the route for sediment to the coastal marsh and contributed to the already rapid loss of wetlands in the lower Terrebonne and Barataria Basins. As the EPA (1998: 1.2-3) notes:

> The cause-effect linkage between marsh loss and Bayou Lafourche is as follows.
>
> 1. The natural supply of freshwater from Bayou Lafourche was a major factor in promoting the organic productivity of the marshes in the eastern Terrebonne Basin and the western Barataria Basin. The vertical accumulation of organic matter (plus some sediment accretion) was the most essential process allowing the marshes to remain emergent, despite high rates of local land subsidence.
>
> 2. The delicate balance in which vertical accumulation kept up with subsidence was lost when Bayou Lafourche was dammed. The impacts of this change might have taken a longer time to develop, but hydrologic modifications (e.g. dredging of canals) caused significant stresses to the local marshes, and thereby greatly hastened vegetative death and marsh loss.
>
> 3. Under this concept, the damming of Bayou Lafourche was a contributing cause to a marsh loss problem that also results from natural subsidence and hydrologic modification.

7.3 Proposed Solution

The TDCC would leave the Mississippi River at a point not far downstream of Donaldsonville (see Figure 7.1). A control structure would be needed at this point and the most likely model

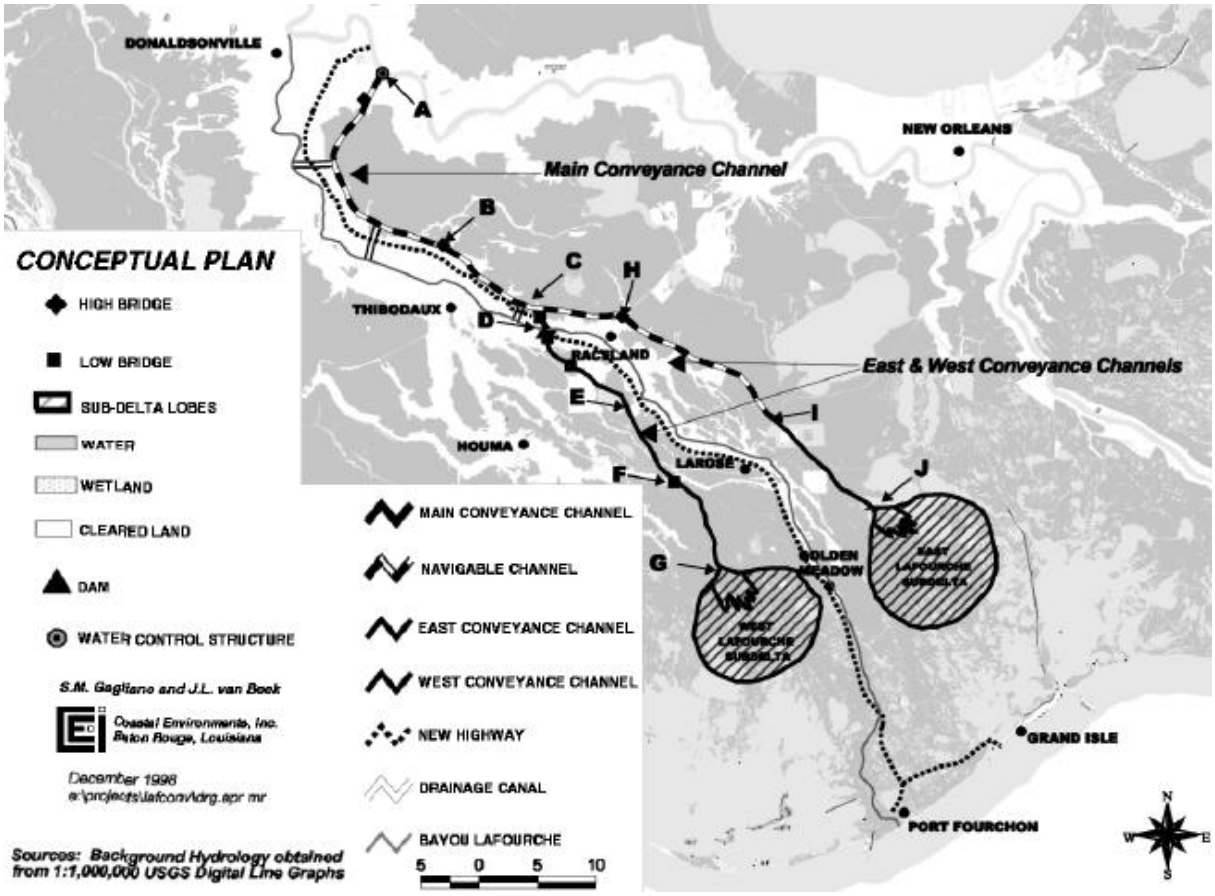

Figure 7.1: Gagliano and van Beek, Third Delta Conveyance Channel

for this is the Old River Control Structure that controls the flow from the Mississippi into the Atchafalaya River although the Bonnet Carre Spillway, Davis Pond Diversion Structure, Caernarvon Diversion Structure, and the Wax Lake Outlet Structure are also being examined (CH2MHILL 2004b). While Gagliano and van Beek (1999) discuss the possibility of a lock at this point and such a lock would potentially facilitate the use of the section of the conveyance channel between the Mississippi and the GIWW for vessel traffic and possibly industrial development, CH2MHILL (2004b) does not address this option. From the control structure the conveyance channel would flow generally south and southeastward more or less parallel to and on the east side of Bayou Lafourche and the eastern natural levee of the bayou. This main channel would split into a western arm and an eastern arm at a point somewhere between Raceland and Thibodaux, on the eastern side of the bayou. From there the eastern arm would continue a track southeastward on the eastern side of Bayou Lafourche. The western arm would cross Bayou Lafourche and track southeastward on the west side of the bayou. All three channels (main, east and west) would be impounded by levees. Impoundment and channel would deliver sand and silt from the Mississippi River to a point 10-15 miles northeast of Golden Meadow (eastern arm) and to a point 10-15 miles southwest of Golden Meadow (western arm) where most of the marsh building would occur.

The only extensive analysis of the TDCC project to date is a phase 1 study by CH2MHILL (2004b). The limits of that study are clear in the statement "[T]he Louisiana Department of Natural Resources authorized this reconnaissance-level study to evaluate the general feasibility of the TDCC project concept." (CH2MHILL 2004b:ES-1) This is clearly a conceptual study that addresses the technical (i.e. engineering) feasibility of the project. Details of how, where, and when the project would be started are not known. There are no cost estimates for the project, although anecdotally figures in excess of $3 billion have been tossed around.

In terms of the physical aspects of the project, CH2MHILL (2004b:ES-2) concluded that:

> 1) The diversion structure, channel, and flood protection levees can be constructed. The channel levees can be constructed to USACE design standards by using *in situ* materials and typical levee construction practices.
>
> 2) Adequate sediment load is available in the Mississippi River for delta building.
>
> 3) Sediment and sand from the Mississippi River and eroded pilot channel can be transported to the proposed delta building sites.
>
> 4) A pilot channel with a discharge of at least 40,000 cfs is necessary to produce the desired channel erosion.
>
> 5) The proposed delta building sites can potentially receive more sand, retain more sand, and build land faster than is currently being exhibited at the Wax Lake Delta in the Atchafalaya Bay.

In short, the TDCC project is at the stage where at least one study believes the project is technically feasible, i.e. it can be done. Other than delta building, however, the effects of this project are largely unaddressed or are at the back-of-the-envelope calculation level. Extensive research would have to be done to assess the effects of a project of this magnitude and there are virtually no precedents to guide this research. A number of issues arise with this project.

7.4 Issues

While the Wax Lake Outlet was used as the inspiration and justification for the TDCC (see discussion above) there are notable differences between the existing outlet and the proposed conveyance channels. Originally designed as a flood control measure, the Wax Lake Outlet has become the classic example of a sediment diversion success story. The outlet was dug through the natural levees of Bayou Teche in 1942 as a U.S. Army Corps of Engineer's project. In the ensuing decades the outlet has scoured to become a major distributary of the Atchafalaya River, at peak flow carrying over 200,000 cfs. The flow of the Red and Mississippi River water through the Atchafalaya River and the Wax Lake Outlet into the shallow waters of Atchafalaya Bay has resulted in sediment deposition and land formation, in the form of an extensive new delta. The new land deposited by the outlet (and that deposited by the Atchafalaya River itself) have been designated as a state wildlife management area.

The outlet is the only diversion that approximates the volume proposed for the Third Delta project. However, the Wax Lake Outlet was dug in 1942, approximately 15 miles long, through an isolated section of the Atchafalaya Basin, 27 years before the passage of the National Environmental Policy Act (Pub. L. 91-190, 42 U.S.C. 4321-4347). In contrast the TDCC would be constructed in the 21st century, 105 miles long, through a much more heavily populated area and with NEPA – which requires addressing the environmental and human impacts of a project – in effect.

The alignment for the TDCC identified by Gagliano and van Beek extends approximately 105 miles. Assuming a total project right-of-way of 1,500 feet, the project footprint would impact approximately 15,000 acres of undeveloped land (90 percent of which is emergent or forested wetlands), 3,200 acres of developed land, and 900 acres of open water. This is a total project footprint of approximately 30 square miles. The levee construction would intercept natural runoff from land along the Bayou Lafourche Ridge. This is in an area where Tropical Storm Allison dumped 29.86 inches of rain in Thibodaux, in 2001. Within the Barataria Basin, a drainage area of approximately 80,000 acres (125 square miles) would be impacted (CH2MHILL 2004b). This would likely require some form of collection ditches and pumping stations for (forced) drainage. Thus, the total project impact would be on an area of approximately 155 square miles.

One of the more important points in the design of the TDCC project is that it is conceived of as a very long term process. The current thinking is for the control structure on the Mississippi and any additional control structures (e.g. where the TDCC crosses Bayou Lafourche) to be built up front. The channels would initially be dug to a capacity to carry approximately 40,000 cfs. It is assumed that the channels would then be scoured over the **20 - 60** year period following its construction to the final desired capacity of 200,000 - 300,000 cfs. It is also important to note that the 20 - 60 year period starts after the project is approved and constructed, neither of which is anticipated in the near future.

In addition, 300,000 cfs – the desired maximum – is half the average flow of the Mississippi River, 600,000 cfs. The calculation that is most commonly used[2] is that the TDCC would get 40% of the volume of the Mississippi River over 250,000 cfs. This is based on maintaining the historical division between the Mississippi and Atchafalaya Rivers and on the minimum 250,000 cfs needed for safe navigation and to protect fresh water supplies from saltwater intrusion on the Mississippi (Templet and Meyer-Arendt 1988). Figure 7.2 shows the average daily flow of the Mississippi River at Baton Rouge, the projected flow of the TDCC using the formula above and Gulf of Mexico hurricanes of the last 150 years.. Using the above formula, if the TDCC had been in operation in 2005, it would have reached maximum volume for only 18 days in January and February and would have not flowed at all, except for 14 days, during the entire months of August, September, and October. The average flow during these 14 days would have been 13,285 cfs.

Related to the flow regime above, the issue of salt water intrusion into these very large proposed conveyance channels and the subsequent destruction of wetlands is a real issue.

[2] Although any final decisions are far from complete.

This has been a widely acknowledged, enormous problem with the Mississippi River Gulf Outlet (MRGO) southeast of New Orleans, as CH2MHILL (2004b:6-3) notes:

> Erosion has increased the width of the MRGO to over 2,000 feet in places, therefore exacerbating the problem of seawater intrusion. Overall, estimates of the loss in wetland acreage associated with the construction of the MRGO top 19,000 acres (USACE, 1999). The MRGO is widely viewed as an environmental disaster, and recent efforts at closing the MRGO to deep draft vessels have gained the attention of state and federal agencies. USACE is conducting a reevaluation study of the MRGO, and a Task Force was formed to study phasing out the shipping channel.
>
> The lessons learned from the construction of the MRGO will be taken into consideration in the design of the TDCC. The issue of salinity intrusion and associated habitat change is applicable to the TDCC project. The mistakes made in the past will not be repeated in the design of the TDCC.

How the lessons learned from MR-GO would be used is unclear. In addition, as Figure 7.2 shows tropical storm and hurricane frequencies peak at the same time water flows through the TDCC would be lowest, or non-existent. This raises the issue of storm surge associated with tropical systems and an even greater potential for salt water intrusion even with minimal flows. Although the shallower mouths of the conveyance channels will theoretically prevent some of the problems associated with MRGO, given that the waters in the discharge areas are pretty well mixed across the water column, there appear to be unanswered questions still.

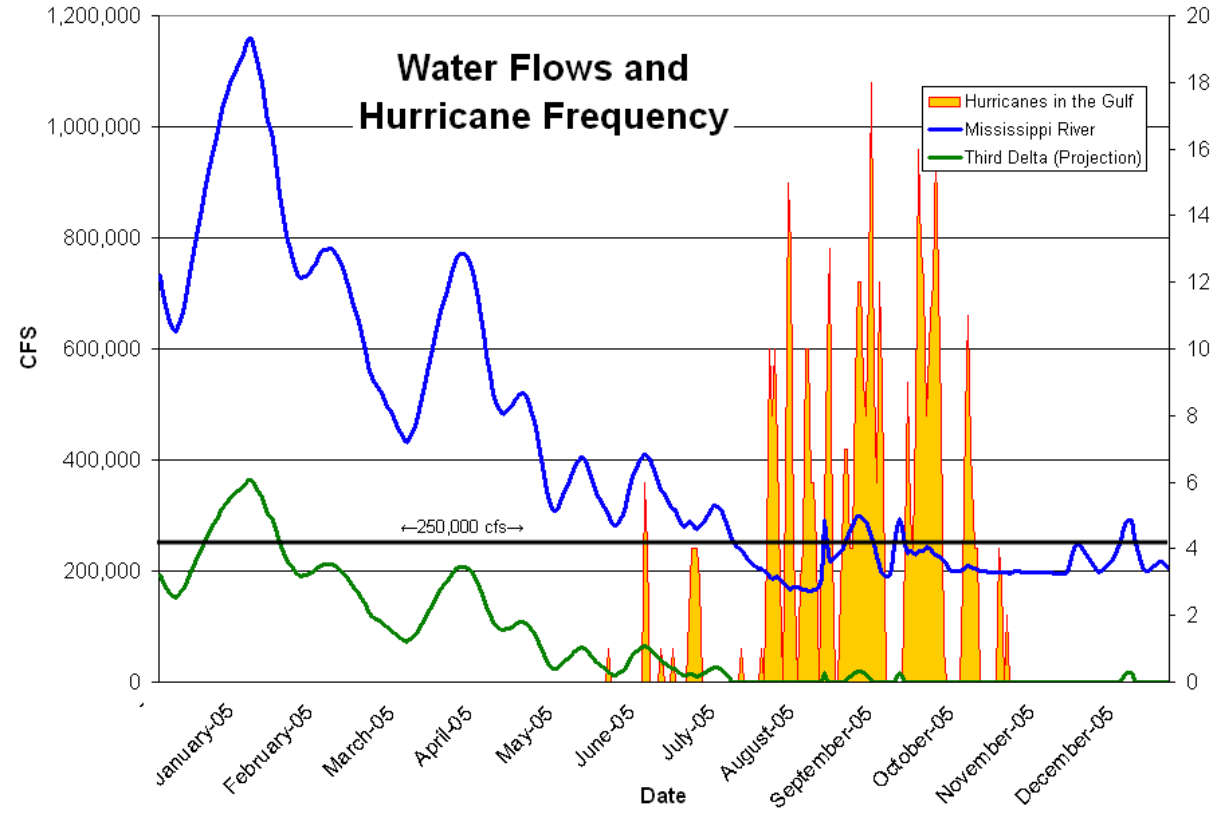

Figure 7.2: Flow Rates 2005, Hurricanes in the last 150 years

Sources: USGS gauge #7374000 Mississippi River at Baton Rouge; National Oceanic and Atmospheric Administration http://www.nhc.noaa.gov/pastprofile.shtml

The TDCC project will cause major salinity changes in the Barataria and Terrebonne drainage basins. These changes and the extent to which they will alter the respective ecosystems have not, to our knowledge, been modeled at this preliminary stage of the project. The effect of ecosystem level changes on commercial and recreational species are unclear, but there are certain to be effects. Since the people who live in the affected area have an especially intricate relationship with their local flora and fauna, we would expect there to be more cultural upheaval due to these ecological changes than in an urban population, although the recreational use of the area extends to individuals throughout, and beyond, the state. Actual migration of human residential patterns is expected to be minor and slow and not generally traumatic to local social networks.

The TDCC project will alter access to traditional wetland use areas from the Bayou Lafourche Ridge. What these alterations will be and what provisions will be made to provide alternative access have not been determined.

The project will impact several roadways (state and federal highways, regional and local roads), two railroad alignments at three locations and will require extensive relocation of oil, gas, and petrochemical pipelines. While there are 81 potential pipeline relocations for the Bayou Lafourche Project (see details above) – depending on the alternative chosen – because the portions to be relocated are on the natural levee and under a water body, both construction and permitting activities are less of a problem than with pipelines that have to be moved for the TDCC which are primarily in wetlands.

The project would also have potentially large impacts on cultural resources. Certainly the actual 30 square mile footprint of the project and quite possibly the 125 square miles of impacted drainage area would have to be surveyed for prehistoric and historic sites. The number of potential sites cannot even be estimated, because most of this area has never been surveyed. The Gheens quadrangle map (1:24,000) in the State Archaeologist's Office shows 114 prehistoric sites on the areas that have been surveyed. Surveying the area would be a massive task by itself. Sites that were found would have to be tested for potential inclusion in the National Register of Historic Places and those found to be eligible would have to be mitigated. Mitigation means avoiding the site, or extensively excavating it.

The implications for storm surge and runoff within the 125 square mile area of impacted drainage are unclear. The lands paralleling Bayou Lafourche are in a low-lying areas that are subject to flooding. CH2MHILL (2004b:CR-12) note:

> Because of the relative importance of flood control in the region, it is recommended that, for those areas that the TDCC would potentially isolate, a conceptual design of storm drainage requirements should be developed. Flood control and stormwater investigations should be completed in conjunction with regional flood protection planning in the Barataria and Terrebonne Basins.

The sediment load of the Mississippi River is not unlimited. Removing an estimated 18-25 million tons a year (CH2MHILL 2004b:CR-18) for the TDCC means that this is not available for use further downstream, possibly at locations closer to where deposition is desired, with a process that costs less and produces fewer environmental and social impacts. CH2MHILL (2004b:CR-12) obliquely acknowledges this issue:

> A regional discharge and sediment budget should be prepared to analyze the impacts of a potential TDCC diversion on competing sediment and discharge needs in the Lower Mississippi River.

How the crossing of Bayou Lafourche by the western split of the conveyance channel would be handled has not yet been determined. This is especially critical as the TDCC would interact with the Mississippi River Water Reintroduction Into Bayou Lafourche project (discussed above) assuming both projects were constructed. As CH2MHILL (2004a:3-15) note:

> In accordance with the original concept, a dam would be required on Bayou Lafourche at the crossing of the conveyance channel, creating a lake on Bayou Lafourche upstream of the dam. A pumping station would be located at the

> dam (Gagliano and van Beek, 1999). Further investigation will be required to assess alternatives to channel impoundment and potential effects on water supply and natural resources. This analysis will be conducted in Phases 2 and 3.

CH2MHILL conclude with "Further investigation is recommended to evaluate alternatives to an impoundment of Bayou Lafourche and assess the potential effects on water supply and natural resources" (2004b:CR-12). Consider the problems with getting the flow of Bayou Lafourche past the TDCC during a rain event such as when Tropical Storm Allison dumped 29.86 inches of rain in Thibodaux, in 2001. In addition the TDCC will cross the GIWW at two locations, possibly requiring lock systems to prevent impacts to navigation – although Gagliano and van Beek (1999) note that the Wax Lake Outlet already crosses the GIWW.

Property rights issues for the right of way will be complex but more manageable given that the 2003 Louisiana State Legislature inserted paragraph F "[F]urther, the legislature may place limitations on the extent of recovery for the taking of, or loss or damage to, property rights affected by coastal wetlands conservation, management, preservation, enhancement, creation, or restoration activities" into Article 1 §4 "Right to Property" of the state constitution.

7.5 Survey

In terms of the Bayou Lafourche area survey (see details above and in appendices A and B), the majority of respondents have not heard about the TDCC project (51%), and those who have heard of it vary considerably in their familiarity with the details of the project, with only ten percent (5% of total sample) saying they were very familiar with the project. Of those respondents who have heard about the project, the majority of them favor its implementation. Respondents admit that they lack information about the project, but most recognize that it is intended as a coastal restoration project. Most are uncertain of its overall goals, design, impacts and implementation.

Respondents' location does influence how much they know about the project and whether they favor it's implementation or not. Opposition to the project is more likely to come from respondents living in the northern region of the bayou. They question whether it will be successful in creating new deltas and they tend to focus on the destructiveness of the project to the environment, the high costs of implementing the project, and the slow return on investment as new deltas will not emerge for many years. Those living along the southern region of the bayou are more likely to think that the project will be successful at creating new deltas in the Barataria and Terrebonne Bays. They tend to stress the benefits that could result from the project and focus on the need to do something now rather than waiting.

Gender did factor into the analysis of the Third Delta project. Males claim to be more familiar with the project, especially it's goals and potential impacts. Females are less certain as to the goals of the project and its range of impacts. Overall males and females know little about the design and implementation of the project.

Respondents favor the project if they view it as a project to create and benefit coastal marshes while not destroying the environment. They want action to be taken as soon as possible and see the project as having mostly positive outcomes. Respondents who fear that the project will place them at greater risk for flooding or place existing wetlands in a position of eroding overwhelmingly oppose the project and are more likely to cite the costs to the environment as prohibitive. Before supporting such a project, these respondents want existing channels and canals to be used to create new deltas rather than digging new channels.

7.6 Summary

The TDCC is a massive project with potentially high benefits and costs that would permanently alter 155 square miles of Louisiana. By way of comparison Orleans Parish is 181 square miles. The benefits are the building of deltas in Barataria and Terrebonne Bays and the associated addition to coastal wetlands, but even here the expected results are only comparative. "The conclusion of the delta building analysis is that the selected delta building locations will receive more sand, retain more sand and build land faster than the Wax Lake Delta has built land in Atchafalaya Bay" (CH2MHILL 2004b:ES-6). Given the very preliminary nature of the studies to date, it is impossible to do more than speculate about both the environmental and social costs. If the project continues to go forward, extensive research will be necessary to assess the effects of a project of this magnitude and there are few precedents to guide a research effort of this magnitude.

The TDCC project is a bold experiment, but it must be kept in mind that it is an experiment and that it is very likely that we will not know the full effects of this experiment until it is way past the stage where its impacts will be revocable!

8.0 Conclusions

As the Teche/Vermilion project has shown even long distance, small flow projects can be mostly a success. As the Wax Lake Outlet has shown even very large flow, short distance projects can be mostly a success. However, as Caernarvon demonstrated even short distance, small flow projects, that do not take human usage fully into account can have significant unintended consequence, including the construction of projects that are not allowed, because of social considerations, to function to their full design goals and ecological objectives. Table 8.1 compares the projects.

Table 8.1: Project Comparisons

	Costs	Footprint	Capacity (cfs)	Ecological Effects	Social Effects
Teche/ Vermilion	Small	Medium	1000	Flooding, freshwater ecosystem restoration	Dissatisfaction, erosion and flooding at the source, increased water supply
Caernarvon	$2,526,129	Small	8000	Salinity change, marsh building	Oyster Lawsuit, Change in Constitution, Restoration of salinity regime
Wax Lake Outlet	Medium	Medium	200,000	Flooding, Salinity change, Marsh building	Flooding - problem corrected Creation of wetlands
Bayou Lafourche	$61,000,000 - $179,000,000 est	Medium	1000 - 2000	Intended: Water supply and freshwater ecosystem restoration, Unintended?	Loss of structures on Batture, Water supply increase
Third Delta	Huge	Huge	200,000 - 300,000	Intended: marsh building on either side of the Bayou Lafourche. Unintended?	Huge potential property access/takings issues.
Cubits Gap	None	Small	Mean > 60,000	Massive Marsh Building	All beneficial

The Bayou Lafourche project is similar to the Teche/Vermilion project in scope, operation and potential social impacts. The two projects are somewhat different in their positive effects. Both address water quality and quantity issues, both provide modest restoration results. While the quantity issue for the Teche/Vermilion project was agricultural use, for the Bayou Lafourche project it is human consumption.

The Third Delta Conveyance Channel (TDCC) project is different, by orders of magnitude, both in its potential restoration effects and in its potential social impacts (see Table 8.2). The

potentially beneficial result of the project is the significant wetland building that would occur in an area where wetlands are vanishing rapidly, but there are other effects of this project, many of which are also significant, as yet unknown, and have large potential for social impacts. These are:

1. The alteration of the drainage patterns in approximately 125 square miles of the Barataria Drainage Basin, an area that is subject to flooding.

2. The 30 square mile footprint of the project itself, most of which is currently emergent or forested wetlands.

3. The alteration of the salinity regimes of two major estuary systems – Barataria and Terrebonne Bays – with potential for impacts on commercial and recreational harvest of numerous species.

4. Unanswered questions involving potentially significant saltwater intrusion.

5. The significant alteration of access to large areas of private property.

6. The potentially large impacts on cultural resources.

7. How the TDCC would interact with the Mississippi River Water Reintroduction Into Bayou Lafourche project is unclear, assuming both projects were constructed.

8. The time period involved, decades to get approval, 20 - 60 years to reach full operational size.

9. The cost of the project.

10. The unassessed specific social impacts that cannot even be addressed until the project configuration is more specific.

11. The project is unknown to a significant portion of the local population and poorly understood by many of those who have heard about it. As the details of the project emerge, potential conflicts with current human activities will become more evident.

12. The project's flow will be dependent on water availability from the Mississippi River.

Table 8.2: Temporal Phase of Development and System Impacted

Lafourche TDCC	**TEMPORAL PHASE**		
SYSTEM IMPACTED	OPPORTUNITY/ THREAT	DEVELOPMENT/EVENT	ADAPTATION/POST-DEVELOPMENT
PHYSICAL	Decline of maintenance on structures in batture. Little knowledge about project, potential issues with increasing knowledge	Increased water levels and water quality, loss of structures in batture Salinity changes, drainage changes, 30 sq. mile footprint, loss of access to property	Potential increased recreational use Potential recreational and commercial harvest of coastal resources with delta formation
CULTURAL	unknown	Salinity change alter species available for commercial and recreational harvest, cultural resources impact	Potential changes in commercial harvest, species and techniques
SOCIAL	Potential for new organizations, time money energy spent for support of or resistance to proposed development	unknown	Potential alteration of human capital, refocus on skills with application in new development
POLITICAL LEGAL	Declines in property value with drainage and access issues, real estate speculation depending on configuration	Maintenance dredging New drainage and maintenance regulatory oversight	New regulatory structure depending on final project configuration
ECONOMIC	Decline or increase in property values, speculation, investment	Cost of project, short term construction impacts. Cost of Project, longer term construction impacts	Potential growth of tourism Unknown potential alteration of local economy, occupations
PSYCHOLOGICAL	Little local knowledge of project, potential issue as knowledge increases	Stress associated with long term construction effects	unknown

Given the controversy and disruption caused by one segment of one stakeholder group that had very limited rights at stake, that came to surround a relatively minor diversion – Caernarvon – it is not clear to us how the issues surrounding the TDCC can be resolved in such fashion that this project can be constructed in its currently proposed location. Given the problem of coastal wetlands loss the TDCC proposal seems to arise out of the question of: how do we put the lost wetlands back where they were? rather than: where can we rebuild wetlands most efficiently and with acceptable social, economic, and ecological consequences? Had this second question been asked first, it is possible that the TDCC would have never reached the planning stage.

Given the life span of humans and even human communities, the relationship between humans and geological processes is a complex one. Attempting massive changes to an ecosystem that humans live, work, and play in – even if it is to restore it to some former state – is always problematic. However, if you create a new ecosystem in an area of current low use, that humans want to work and play in, they will figure out how to access it even if it takes generations.

Humans live and thrive from the North Slope of Alaska to the Amazon rain forests. They are the most adaptable species on the planet. So human adaptation, both to environmental change in coastal wetlands and wetland restoration projects should be a consideration in policy decisions, but the networks, skills, limitations and dignity of those being asked to adapt must be taken into consideration. Many coastal residents have finely honed skills, but limited resources to affect change. Moving the residents of a small, functioning, but threatened, community into an urban apartment building is not adaptation.

In 1862, so the story goes, a Mr. Cubit, or his daughters, dug a trench across the natural levee of the Mississippi River, on the east bank, near the present day Pilot town (current River Mile 3), with a shovel (Loyola University Center for Environmental Communications). The trench scoured out and became a distributary of the river. Cubit's Gap, as it is now called was an

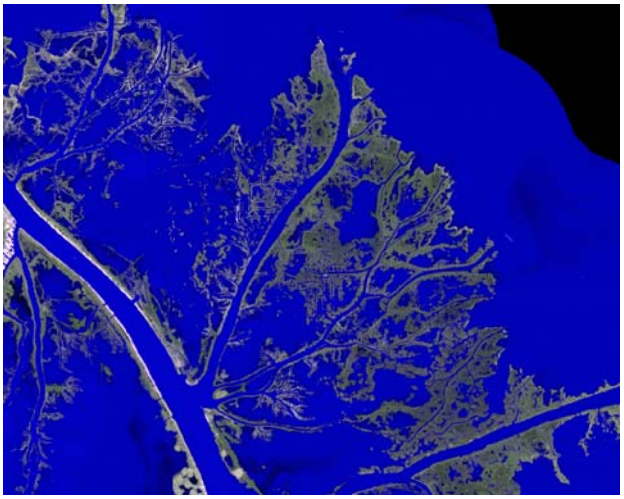

Figure 8.1: Cubit's Gap Delta

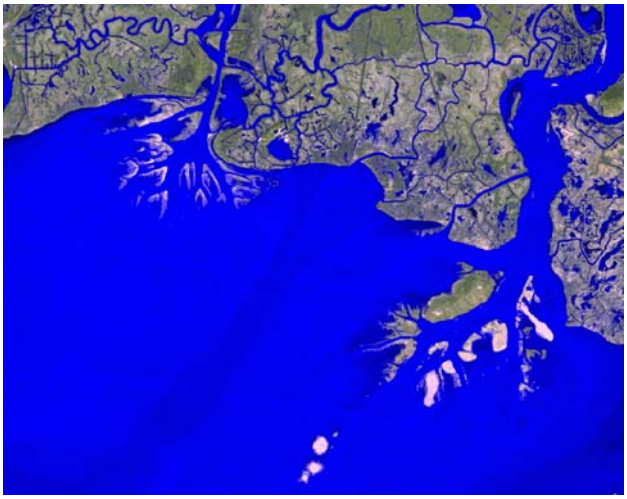

Figure 8.2: Wax Lake Outlet and Atchafalaya River Deltas

unintended, early diversion project which now captures approximately 10% of the river flow and has built 48,000 to 49,000 acres of marsh, which became a National Wildlife Refuge in 1935. It

could probably stand as an example of the perfect marsh creation project, no cost, no engineering problems, no negative social impacts, and massive results. This "diversion" compares favorably with the Wax Lake Outlet and Atchafalaya River in terms of delta building as the combined total of these two are 27,000 acres. Figures 8.1 and 8.2 compare these two delta building operations using the same scale.

The lesson here appears to be a simple one, that it is time to recognize that some projects cannot be done because of social considerations and stakeholder interests and some can be done more easily for the same reasons and that **these considerations need to be taken into account very early on, probably before we even consider how a project can be engineered.** In short, we need first to look for opportunities **where** restoration and marsh creation projects – given their size, configuration, and effects – **can** happen and can be allowed to function at their full restoration potential. If large scale diversion projects are necessary, then where can they go?

Here there are also policy considerations. For example, given the recent past, is the greatest need to build wetlands for the protection of New Orleans? If so given the destruction by MRGO, and the very low rates of usage, should the MRGO channel become a diversion? If not MRGO where else can a large diversion occur that would benefit New Orleans. What about reproducing Cubit's Gap or a larger diversion at mile 19 opposite Fort Jackson, or mile 34 across the river from Nairn, where the momentum of the flow is already heading east? While complete diversions of the Mississippi are being discussed (Dean 2006) these will bring a new player into the mix, shipping interests. Will these ideas require locks which shipping interests will oppose, is there a way to divert most of the river, but maintain Southwest Pass as a shipping channel? These are all questions that need to be on the table.

NRC (2006:163) recommended:

> the development of an explicit map of the expected future landscape of coastal Louisiana should be a priority as the implementation of the LCA Study moves ahead... Development of such a map will also require meaningful stakeholder involvement and the commitment of decision makers at all level of local, state and federal governments.

Such an inclusive process would allow a wide ranging set of competing ideas to be examined at a very preliminary stage, bring potential disruptive effects to the forefront early, eliminate ideas that would result in projects that cannot be done, lead to a more efficient use of planning and engineering resources and the development of successful adaptive responses by the human community.

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Appendix A

Detailed survey results: bayou lafourche water diversion and third delta conveyance channel

Rationale

Residents of the Bayou Lafourche region have more at stake when considering the two projects proposed for their area of south Louisiana. They face the possibility of increased risk to flooding, the chance of losing waterfront property, an increased exposure to the effects of coastal land loss, and perhaps the loss of economic as well as recreational opportunities. To determine the knowledge held by residents and their opinions concerning the Bayou Lafourche project and the Third Delta project we developed and administered a mail questionnaire

Methods

In order to develop the survey instrument we accessed sources that were available to area residents interested in learning about the projects. These sources included local newspapers from the Bayou Lafourche region, Department of Natural Resources website and reports, technical reports from engineering firms, newsletters from regional restoration proponents and internet website. Consulting these documents we constructed questions that addressed the details of the projects including location, construction techniques, goals and potential impacts to local areas.

The three page questionnaire asked if people had heard about the proposed projects, where they heard about the projects, their level of familiarity, knowledge of the specific goals and design of the projects, if the respondents favor or oppose the projects, and why. Demographic questions asked about location, gender, race, age, income and occupation. Most of the questions were closed-ended in format thereby providing respondents with a check box for their response. Questions requiring an explanation were open-ended (see attached questionnaire). Respondents were asked to provide contact information if they were willing to participate further in the survey.

Sample

The DeLorme Street Atlas USA 2006 Plus containing contact information for residents allowed us to search for names and addresses based on zip codes. Zip codes for all geographic areas adjacent to Bayou Lafourche, from Donaldsonville to Leeville were determined. All names and addresses within these zip codes were assembled into a list which was used as our sampling frame. From the sampling frame we randomly selected 5000 residents for sample.

Mail out

Using the inexpensive bulk mailing option, we mailed 5000 questionnaires. Bulk mail is not returned to sender if undeliverable so we are not able to estimate how many questionnaires actually reached the recipient. Postcards were sent by bulk mail to all 5000 addresses two weeks after the original questionnaire was mailed. The postcard served three purposes: 1) it acted as a thank you note for those who had already completed and returned the questionnaire; 2) it served as a reminder to those who had not yet mailed in the questionnaire to please do so and 3) it informed

residents that they could request another questionnaire. Respondents returned 287 completed questionnaires.

Analysis

Basic Demographics of Respondents. The personal characteristics and location of the survey respondents are as follows. The majority of the respondents are male (74%), 24% are high school graduates or the equivalent, 25% attended some college or technical school, 29% have a college or technical school diploma, and 17% have a professional degree. Caucasians represent the vast majority of respondents (88%), while Blacks, Native Americans, Asians, and Hispanics make up approximately seven percent. The average income of respondents is $65333 per year, with only two percent of the respondents earning less than $11000 per year, and eight percent earning over $100,000 per year. The areas of Thibodaux (35%), Raceland (12%) and Cut off (10.5%) had the greatest number of respondents. For the analysis a new location variable was created based on proximity to Thibodaux, with those living in Thibodaux and to the north of Thibodaux comprising one group (n=149; 57%), and those living to the south of Thibodaux the other group (n=114; 43%).

The Bayou Lafourche Water Diversion Project

Hearing, Familiarity, Favor or oppose. Concerning the project to pump more water from the Mississippi River into Bayou Lafourche 82% of respondents have heard about the project while 18% have not. Of those who have heard of the project, 20% are not at all familiar with the project, 66% are somewhat familiar and 15% report being very familiar with the project. We asked those who reported hearing about the project if they favored or opposed it. The majority (85%) reported being in favor of the project.

Knowledge of Project Specifics. When questioned about the possible outcomes of the Bayou Lafourche project, 65% believe it will create and protect coastal wetland habitat. Concerning water issues, 69% report it will supply fresh drinking water to area towns, 71% think it will not increase salt water intrusion, 47% say it will not cause flooding in Bayou Lafourche towns although 37% are not sure about flooding.

Concerning environmental effects, 43% believe it will change fisheries in the area yet another 41% are not sure about its effects on fisheries. Sixty one percent state that it will benefit marshes in Terrebonne and Barataria Bays, 30% reply that it will not cause water in the bays to be muddier while 46% are not sure. Sixty four percent say it will cause water in the bays to be fresher.

When asked about improvements to the bayou, 48% claim it will create more recreational opportunities while another 40% report not being sure; 31% believe it will promote tourism but many are not sure (48%).

Concerning project implementation 45% think it will require dredging and 46% are not sure if dredging will be necessary; 30% believe it will not require the relocation of gas and oil pipelines but 57% are not sure about this issue. Thirty percent say it will not require the replacement of bridges although 47% report not being sure.

To maintain the project for the long term, 51% responded that it will include a pumping station but 44% are not sure, 64% think it will include monitoring stations and 41% believe it will require bulkheads to prevent erosion of bayou property. Forty-six percent are not sure about the need for bulkheads.

Favor or Opposed analyzed by Familiarity and Project Specific Questions. Those who claim that they are very familiar with project are more likely to favor the project (88.6%) as are those who claim to be somewhat familiar with the project (88.4%), 67.7% of those who claim to be not at all familiar with the project also voice support for the project.

Respondents who favor the project tend to think that the project will create coastal habitat (83%) whereas those who oppose tend to think the project will not create coastal habitat (33%) or are uncertain if it will create coastal habitat (52%). Over 86% of respondents who favor the project believe the project will protect coastal habitat, while those who oppose the project tend to think the project will not protect coastal habitat (39%) or are unsure (52%).

Respondents who favor the project replied that the project will supply fresh drinking water to area parishes (81%) whereas those that oppose the project tend to nearly equally divided between those who think it will not supply fresh drinking water (33%), those who are unsure (30%) and those who think it will supply fresh drinking water to area parishes (36%).

Concerning the possibility of the project increasing salt water intrusion, 86% of those in favor of the project think that it will not increase salt water intrusion. Very few respondents think the project will increase salt water intrusion, but 18% of those opposing the project do think it will increase salt water intrusion.

Those who favor the project tend to think the project will not cause flooding in Bayou Lafourche towns (62%) but those who oppose the project do think the project will cause flooding (68%). When asked about changes to fisheries, 38% of respondents who favor the project think fisheries will change as a result of the project. For those in opposition to the project 70% believe that fisheries will change if the project is implemented.

If respondents favor the project they maintain that the project will be beneficial to the marshes (77%), however those who oppose the project tend to think the project will not benefit the marshes (70%).

Respondents who favor the project tend to think that the project will not make the bays muddier (36%) or are uncertain if the bays will become muddier (46%) whereas those opposed to the project think it will make the bays waters muddier (56%). Respondents in favor of the project do think the project will result in fresher bay waters (77%), but those opposing the project are split between those who tend to think the project will not result in fresher bay waters (44%) and those who think it will result in fresher bay waters (38%).

Those in favor of the project are more likely to claim that the project will create recreation opportunities (61%), but for those that oppose the project they tend to think the project will not create recreation opportunities (45%) or they are uncertain (45%). A similar pattern was found for

tourism, where 40% of respondents who favor the project expect that the project will promote tourism and 65% of respondents who oppose the project think that it will not promote tourism.

Regardless of whether they favor or oppose the project, there is a high level of uncertainty as to if oil and gas pipelines will have to be moved (52% of each group). Respondents who favor the project believe that oil and gas pipelines will not have to be moved (37%) . When respondents oppose the project they are more likely to think that the project will require the relocation of oil and gas pipelines (29%). A similar pattern is found for the replacement of bridges. Over 38% of respondents who favor the project replied that bridges will not have to be replaced. Those who oppose the project are more likely to think that bridges will have to be replaced (56%). The same is true concerning the need for bulkheads. Respondents favor the project expect that bulkheads will not be needed (18%) or are not sure (49%), whereas those that oppose the project are certain that bulkheads will be needed (81%).

Why in Favor or Opposed to the Bayou Lafourche Water Diversion Project. Respondents were asked to explain why they favor or oppose the Bayou Lafourche Project. The most frequently occurring responses for those **in favor** of the project are: 1) Coastal restoration, including references to marsh and wetland restoration, coastal erosion, restoring the barrier islands, creation of land, and bringing more silt and nutrients into the area; 2) Improvements to Bayou Lafourche, including adding fresh water to improve water quality in general and specifically the quality of the drinking water, bayou productivity, and the flow of the bayou; 3) Stopping salt water intrusion into the bayou; 4) Returning the bayou to it's natural condition; 5) Ecological and environmental improvements, including creating and preserving habitat, improving area fishing, and bringing back the abundance and variety of wildlife; 6) Recreational improvements; and 7) Statements to the effect that this is the most efficient option that will improve the area.

The most frequently occurring responses for those **opposed** to the project are: 1) Flooding, drainage and the capacity of the bayou to take on more water; 2) Loss of property and erosion of the bayou banks; 3) Costs outweigh the local benefits; 4) Pollution; 5) Don't want to see the bayou change; and 6) Statements to the effect that the project will not help.

The most frequently occurring response for those **neither** in favor of or opposed to the project is that they didn't know enough about the project to have an opinion.

Most Important Thing We Should Know about the Bayou Lafourche Project. We asked respondents to tell us what they thought was the most important thing we should know about the Bayou Lafourche Project. The most frequently occurring responses for those **in favor** of the project are: 1) Restorative prospects of the project, including the restoration of land (and lessening erosion), wetlands, marsh, and habitat, the return of water flow and water levels to the bayou, and the restoration of the beauty of the bayou; 2) Impacts/Effects of the project, including drainage and flooding, environmental, fisheries, water quality, long term effects on the residents and land owners of the area; 3) The absolute necessity of the project, that action is needed now, that time is critical and that doing nothing will result in greater losses; 4) The need to weigh the pros and cons, including that there are more positives (benefits) than negatives (drawbacks) associated with the project; that trade-offs are inevitable, and that some will have to sacrifice land for the greater good; 5) Costs including the initial cost of construction and the future cost of maintenance, and

budget specifically questioning who will manage the budget; 6) Time frame for the construction of the project especially the start up date for construction, how long to complete, and when will results be evident; 7) Comments concerning the construction process including the need to dredge the bayou, the need for strict monitoring of the construction and maintenance, the need to raise areas along Hwy 308, and the need for bank stabilization and bulkheads; and 8) Those who want a guarantee that the project will really help, those that question if it will really help and those who want to go ahead with the project even though they don't think it will help.

The most frequently occurring responses for those **opposed** to the project were: 1) Flooding will increase along the bayou; 2) Property along the bayou will be lost due to erosion as the size of the bayou increases; 3) Costs, including that it was too costly, that property owners will need to be compensated for their losses, that the construction costs of levees will be too great, and that the costs outweigh the benefits; 4) It won't work or they don't want it; 5) that the project is a political project designed to create opportunity for a few people and not a restoration project, specifically that it is not a CWPPRA project, will not benefit the marshes, and is being governing by politics and therefore should be paid for with other funding.

Where Respondents Heard About the Bayou Lafourche Project. The most frequently occurring responses for those **in favor** of the project are: 1) Media, including newspapers, radio, television, news, magazines, newsletters, articles, and displays; 2) Area residents including friends, family, locals, neighbors, hearsay, and word of mouth; 3) Organizational and/or community meetings, including parish councils, port commissions, town meetings, water district meetings, BTNEP, Restore or Retreat, Barataria/Terrebonne Estuary Project, Les Reflections du Bayou and speakers; 4) Representatives from The Army Corps of Engineers, the Department of Natural Resources, researchers, and professionals; 5) Libraries including those located at Nicholls State University and the Thibodaux Public library; 6) Internet web-sites and email correspondence; and 7) Those who are uncertain where they heard about it, have not heard about it, or heard about it through this research (i.e. the questionnaire).

The most frequently occurring responses for those **opposed** to the project are: 1) Media, including newspapers, radio, television, and news; 2) Area residents including friends, family, people talking, hearsay, around town, here and there and associates; 3) Organizational or community meetings including the Bayou Lafourche Fresh Water District and politicians, 4) Engineers and studies; and 5) Those who are uncertain where they heard about it, have not heard about it or heard about it through this research.

The most frequently occurring responses for those **neither** in favor of or opposed to the project are: 1) Have not heard of the project, or first heard of it through this research; 2) Media, including newspapers, TV, radio and news; 3) Friends, co-workers, public, overheard conversations, and patients; and 4) A meeting with the Chamber of Commerce.

Responses analyzed by Location. There are significant differences found in responses based on location. Although the majority of respondents favor the project, a greater percentage of residents located in Thibodaux and to the north of Thibodaux oppose the project (22%) compared to those to the south of Thibodaux (7.5%).

The majority of respondents believe that the project will protect coastal habitat, however, 10.5% of those who live in Thibodaux or north of Thibodaux report that it will not protect coastal habitat compared to only 3.5% of respondents living south of Thibodaux.

Most replied that the project will improve the quality of the drinking water, however, if residents think it will not then they are more likely located in Thibodaux or north of Thibodaux (12.2%) rather than south of Thibodaux (2.7%).

Respondents were asked if they thought the project would increase salt water intrusion in Bayou Lafourche. The majority of respondents replied that it will not, but 12.2% of respondents in Thibodaux and north of Thibodaux replied that it will, compared to only 3.5% of respondents living south of Thibodaux.

Respondents are less certain about the possibility of the project leading to increased flooding in bayou towns with 36% stating that they aren't sure and 47.5% believing that it will not. However, 20.1% of the respondents in Thibodaux and north of Thibodaux replied that the project will increase flooding compared to 11.4% of respondents south of Thibodaux.

When asked if the project will increase fresh water in the bays, the majority stated that it will, but 15.6% of respondents in Thibodaux and north of Thibodaux believe that it will not increase the freshness of the water in the bays compared to only 4.4% living south of Thibodaux.

Many of the respondents (48.3%) believe that the project will create recreational opportunities along the bayou, however 16.6% of those living in Thibodaux or north of Thibodaux think it will not compared to 7% of residents living south of Thibodaux.

There is a high level of uncertainty concerning whether some of the bridges located along the bayou will need to be replaced because of the increased flow of water resulting from the project. Nearly 46% say they are unsure, but 30% of the respondents from Thibodaux and north of Thibodaux say that it will require the replacement of bridges compared to only 14.7% of respondents to the south of Thibodaux.

Many respondents are not sure about the need for bulkheads (43.2%) but 49% of residents living in Thibodaux and north of Thibodaux stated that bulkheads will be needed to protect property compared to 36.8% of residents living south of Thibodaux.

Location did not influence responses to the remainder of the questions (hearing of the project, being familiar with the project, the projects ability to create habitat, change fisheries or benefit marshes, make the bays muddier, promote tourism, require dredging or the relocation of pipelines, or include pumping and monitoring stations) as there were no significant differences in the patterns of responses between those living in Thibodaux or north of Thibodaux and those living to the south of Thibodaux.

Responses analyzed by Gender. Gender proved to be a major explanatory variable when deciphering response patterns of respondents. In most cases, females were more likely than males to be "not sure" of the specifics of the project.

The majority of respondents have heard about the project, but 88.4% of males report having heard compared to 66.7% of females. Males tend to be more familiar with the project as 66.3% responded that they are somewhat familiar and almost 17% stated that they are very familiar with the project. Females are just as likely as men to state that they are somewhat familiar (66%) but they differed from males in that 28.3% report being not at all familiar with the project.

The vast majority of males responded that they think the project will create coastal habitat (70.2%) and protect coastal habitat (72.2%). Just about half of the female respondents think that the project will create coastal habitat (50.7%), while 41.1% are not sure if the project will create habitat or not. Concerning the protection of habitat, 46.4% of females think the project will, but 42.5% are not sure.

Concerning the issue of drinking water, males are most likely to state that the project will supply fresh drinking water to area parishes (81%), but only a third of females answer that the project will supply fresh drinking water to residents. Females are more likely to state that they are unsure if the project will supply drinking water (50%).

The majority of males believe that the project will not increase salt water intrusion (79.5%) while slightly less than half of females (49.3%) respond in the same way. Many females (41.1%) are not sure if the project will increase salt water intrusion.

When asked if the project will cause flooding in Bayou Lafourche towns, 53.9% of males respond that it will not, and 33.5% are not sure of the flooding possibilities. Females express greater uncertainty as 47.9% respond that they are not sure of the flooding possibilities for bayou towns, and only 27.4% say that it will not result in flooding.

The majority of males (69.4%) think the project will benefit the marshes in Terrebonne and Barataria Bays. Slightly more than half (52.1%) of females state that they are not sure if the bay marshes will benefit from the project. Close to forty percent of females think that it will benefit marshes.

Males believe that the project will cause the water in the bays to be fresher (72.3%) whereas females are just as likely to reply that it will (42.3%) as they are to reply that they are not sure (42.3%). Less than twenty percent of males state that they are unsure if the bay waters will become fresher as a result of the project.

Males are almost twice as likely as females to state that the project will create more recreational opportunities (54.4% compared to 26.8%). Again females are more likely to reply that they are uncertain of the recreational opportunities that the project will create (56.3%) compared to the uncertainty of males (34.8%).

When asked if the project will promote tourism, many say they are not sure (56.9% of females and 43.4% of males). Few females are willing to state that it will (19.4%) while males are much more likely to state that it will (43.4%).

When it came to questions concerning the construction of the project, females are much more likely to reply that they are not sure of the need for dredging (61.1%), the need to relocate oil and gas pipelines (77.1%) and the need to replace some of the bridges (56.3%). Many males state that the project will require dredging (51%) and will not require bridges to be replaced (36.3%). Males are also less certain about the need to relocate oil and gas pipelines (51%), although 36.4% replied that it will not. The majority of the respondents agreed that there will be a need for monitoring stations, but 44.4% of females compared to 28.8% of males are not sure.

There are no significant differences in the pattern of responses for males and females when asked about if the project will change fisheries, create muddier bays, need pumping stations, or bulkheads.

Responses analyzed by Education. The respondents level of education did not explain nearly as many differences in responses as the variables of location and gender. Correlations are found between education and familiarity with the project, as well as education and whether the project will require dredging. The higher the level of education, the more likely the respondent is to be very familiar with the project ($r = .140$, $\alpha = 0.05$). The relationship between education and dredging is inverse, meaning the higher the respondent's level of education the more likely they are to reply that the project will not require dredging. Conversely, the lower the respondent's level of education, the more likely they are to reply that the project will require dredging.

The analysis of reveals that 18.8% of respondents with less than a high school education report that the project will not include monitoring stations. Compare this figure to 2.9% or less responding that the project will not require monitoring stations for each of the four other levels of education.

There are no other questions that provide significant differences in response patterns when comparing levels of education of respondents.

Responses analyzed by Income. Income level is also limited in its ability to explain the differences in responses given by respondents. Correlations are found between income and having heard about the project, level of familiarity, protection of coastal habitat, salt water intrusion, and flooding. Specifically, the higher the income of the respondent, the more likely they are to have heard about the project ($r = .183$, $\alpha = 0.01$). The higher the income of the respondent, the more likely they are to be very familiar with the project ($r = .285$, $\alpha = 0.01$). Further analysis shows that 24.4% of those earning $50,000 or less per year are not at all familiar with the project, while those earning more than $50,000 per year are very familiar with the project. The higher the income of the respondent, the more likely they are to believe that the project will protect coastal habitat ($r = .180$, $\alpha = 0.05$). The higher the income level of the respondent, the more likely they are to believe that the project will not increase salt water intrusion ($r = -.175$, $\alpha = 0.05$). Finally, the higher the income level of the respondent, the more likely they are to believe that the project will not cause flooding ($r = -.150$, $\alpha = 0.05$). Further analysis shows that 38.2% of those earning $50,000 or less per year think that the project will not cause flooding compared to 56.1% of those earning more than $50,000 per year who think that it will not cause flooding.

Differences do exist based on the respondents income level for variables asking about the project making the water in the bays fresher and the relocation of oil and gas pipelines. Sixty-five percent of respondents earning $50,000 or less per year believe that the project will make the water in the bays fresher, compared to 72.8% of respondents earning more than $50,000 per year. The percentage of uncertain responses is considerably different as nearly twice the number of lower income earners report being not sure compared to the number of higher income earners who are not sure about the project making the water of the bays fresher. When it came to the question of whether it will be necessary to relocate oil and gas pipelines, higher income respondents are either unsure (52.6%) or think that pipelines will not need relocation (36.8%). Lower income respondents are either unsure (62.9%) or think that pipelines will need to be relocated (15.7%).

The Third Delta Conveyance Channel

Hearing, Familiarity, Favor or oppose. Concerning the project to create a "Third Delta" by building new diversion channels from the Mississippi River into Barataria and Terrebonne Bays 47% have heard of the project; 53% have not. Of those who have heard of the project 28% are not at all familiar with the project, 62% are somewhat familiar and 10% are very familiar with the project. The majority (79%) favor the project while 21% oppose the Third Delta project.

Knowledge of Project Specifics. When asked specifically about the possible outcomes of the Third Delta project, 66% believe it will create coastal wetland habitat and 62% think it will protect coastal wetland habitat. Concerning water issues, 57% state that it will supply fresh drinking water to area towns, 61% believe it will not increase salt water intrusion and 36% responded that it will not cause flooding in Bayou Lafourche towns although 48% acknowledge that they are not sure about the potential for flooding.

When asked about the project's environmental effects, 51% believe it will change fisheries in the area while 36% are not sure. Seventy percent replied that it will benefit marshes in Terrebonne and Barataria Bays, 30% think it will cause water in the bays to be muddier but 49% are not sure about muddiness and 63% believe it will cause water in the bays to be fresher.

Concerning possible improvements to the bayou, 45% believe it will create more recreational opportunities although 41% are not sure. Thirty percent state that the project will promote tourism along the bayou but a larger percentage (50%) admit to being uncertain.

When questioned about project implementation and maintenance, 46% believe it will require dredging but an equal percentage (46%) are not sure. Twenty-two percent think that it will not require the replacement of bridges but the majority of respondents (57%) acknowledge that they are not sure. Respondents state that they believe the project will include a pumping station (47%) while an equal number are not sure (47%). Sixty-two percent think it will include monitoring stations. Thirty percent believe it will require levee construction that will disrupt natural runoff from land along the Bayou Lafourche ridge but a larger percentage (56%) reported that they are not sure. Thirty-five percent of respondents believe it will impact several roads and railroads but another 50% are not sure. When asked about the channels' development 30% think it will develop over time as the initial channels erode to the size of the final channels but the majority of respondents (65%) are not sure. Only 22% agreed that it will not require the relocation of gas and

oil pipelines but 58% simply are not sure. Nineteen percent believe it will not cross Bayou Lafourche possibly sealing off the upper part of the bayou but most (65%) admitted that they are not sure. Some (17%) believe the project could result in a new highway from the River Road to Hwy 90 but 77% are not sure. One-third of respondents answered that the project and resulting highway could open a new commercial and light industrial corridor but nearly two-thirds (61%) are not sure.

Finally, despite all of the uncertainly about the design, implementation, maintenance and effects of the project, the majority (62%) believe the Third Delta Conveyance Channel will create new deltas in Barataria and Terrebonne Bays while 35% of respondents expressed that they are not sure that it will.

Favor or Opposed analyzed by Familiarity, and Project Specific Questions. Most respondents favored the Third Delta Conveyance Channel Project. There is no significant differences between levels of familiarity and favoring or opposing the project. If respondents favor the project they tend to think that the project will create coastal habitat (87%) whereas those who oppose the project are split in their thinking with 44% thinking the project will create coastal habitat, 30% being uncertain and 26% believing that it will not create coastal habitat. A similar pattern is found for the question addressing the protection of coastal habitat. For those in favor of the project 87 % believe the project will protect coastal habitat, while those who oppose the project think the project will not protect coastal habitat (33%) or they are uncertain (41%).

Respondents who favor the project replied that the project will supply fresh drinking water to area parishes (74%) whereas those that oppose the project think it will not supply fresh drinking water (42%).

Those who favor the project tend to think the project will not cause flooding in Bayou Lafourche towns (48%) but 35% of those who oppose the project think the project will cause flooding and a large portion of the respondents are not sure about the potential for increased flooding (62%).

If respondents favor the project they are highly likely to believe that the project will be beneficial to the marshes (90%) but significantly fewer (52%) of those who oppose the project think the project will benefit the marshes. A similar pattern exists when asked about the likelihood of bay waters becoming fresher as a result of the project. For respondents who favor the project they think the project will result in fresher bay waters (83%), but only 44% of the respondents who oppose the project think the project will result in fresher bay waters.

Concerning the possibility of the project increasing salt water intrusion, 81% of those who favor the project report that it will not increase salt water intrusion. For respondents who oppose the project most think it will not increase salt water intrusion (52%) and only 22% think it will increase salt water intrusion but 26% report being uncertain.

Most of the respondents who favor the project responded that the project will create recreation opportunities (61%), but for those that oppose the project they tend to think the project will not create recreation opportunities (41%). A similar pattern is found for tourism, where respondents

who favor the project tend to think that the project will promote tourism (44%) and respondents who oppose the project think that it will not promote tourism (42%).

If respondents favor the projects they are likely to believe that the project will create new deltas in Barataria and Terrebonne Bays (80%). But for those respondents who tend to oppose the project, considerably fewer (48%) believe new deltas will be created as a result of the project.

For those respondents that favor the project they tended to respond that they are uncertain if levees will be required (57%), and split equally between those that think levees will not be required (21%) and those that think levees will be required (21%). Sixty-one percent of respondents opposed to the project think levees will be required. The same is true for the impacts on roads and railroad. For those respondents in favor of the project they tend to be uncertain if roads and railroads will be impacted (45%). Sixty-one percent of respondents who oppose the project think roads and railroads will be impacted.

Respondents were asked if they think the initial channel will erode over time to the size of the final channel. Seven percent who favor the project said it will not. Sixty-four percent of those who oppose the project said it will erode over time.

Fifty-four percent of respondents who oppose the project believe that oil and gas pipelines will have to be moved, with only 12% of those who favor the project believing that pipelines will have to be moved. There is tremendous uncertainty concerning the proposed path of the Third Delta project, with 60% of those favoring the project not being sure if the project will cross Bayou Lafourche. Fifty-two percent of those who oppose the project believe that it will cross the bayou.

Why in Favor of or Opposed to the Third Delta Conveyance Channel Project. Respondents were asked to explain why they favor or oppose the Third Delta Project. The most frequently occurring responses for those **in favor** of the project are: 1) Coastal restoration, including references to marsh and wetland restoration, coastal erosion, restoring the barrier islands, creation of land, and bringing more silt and nutrients into the area; 2) Stopping salt water intrusion or keeping salinity levels low; 3) Alleviate area flooding; 4) It is likely to work and be the most effective; 5) It is needed, not as damaging as the Bayou Lafourche project; and could be good for Lafourche parish.

The most frequently occurring responses for those **opposing** the project are: 1) Costs including that it is much too expensive to consider, that the benefits will be marginal and not apparent for at least 60 years; 2) Use of existing channels would be better; 3) Flooding, drainage, and the possibility of problems during hurricanes; 4) Destruction of Cyprus swamps and wetlands, the Bayou Lafourche ridge lands and increase erosion; 5) Destruction of people's livelihoods and population displacement; 6) Will end up being used as a shipping channel; and 7) Statements to the effect that it can't be done.

The most frequently occurring response for those **neither** in favor of or opposed to the project is that they don't know enough about the project to have an opinion.

Most Important Thing We Should Know about the Third Delta Conveyance Channel. The most frequently occurring responses for those **in favor** of the project were: 1) It's a necessity, need to

do it now before it is too late, and that it is overdue; 2) Coastal restoration, including references to marsh and wetland restoration, coastal erosion, improvements to the swamps and bayous, impeding salt water intrusion, decreasing subsidence; 3) Flooding and effects of area storms, including statements to the effect that it will decrease flooding, but others who wondered if it will increase flooding, those that think it will provide protection from hurricanes and others who question if it will become another MRGO and bring more water into the area during storms; 4) Questions about the effects that implementation will have on the project proposed for Bayou Lafourche; effects on the environment and fisheries; effects on people's lives and the local economy; 5) Questions of why it is being proposed, whether it will work, what the effects will be and what will happen if it isn't done; 6) Questions about consequences, possibility of harm, and the experimental nature of it; 7) Questions about its construction, the need for levees, who will regulate and monitor it once it is complete; 8) Costs; 9) Statements about the need for additional study and 10) One who although in favor of the project stated that, "it would be a big screw up."

The most frequently occurring responses for those **opposing** the project are: 1) Too damaging to consider, will be an environmental nightmare, that we should not be digging more channels or canals; 2) Too costly; 3) Too much of a gamble with an unforeseeable outcome; 4) Flooding; 5) Monitoring; 6) Time frame including how soon it could be started, the length of time to complete, and the time needed to see any benefits; and 7) Statements to the effect that the idea should be stopped, dropped and left alone.

Where Respondents Heard About the Project. The most frequently occurring responses for those **in favor** of the project are: 1) Media, including newspapers, radio, TV, news and magazines; 2) Area residents including "locals", word of mouth, friends and "at work"; 3) Organizational and/or community meetings including the Port Commission, Bayou Lafourche Freshwater District, a public forum, seminar at LUMCON, BTNEP, Restore or Retreat, or "talks"; 4) Those who are uncertain where or if they have heard of it, those who have not heard of it, or those who heard about it through the distribution of this questionnaire; 5) Internet; and 6) Representatives from the Army Corps of Engineers, "various agencies" and Nicholls State University.

The most frequently occurring responses for those **opposing** the project are: 1) Media, including newspapers, radio, TV, news, and letters to the editor; 2) Those who have not heard of it, including "none", "nowhere", and "no"; 3) The street or through hearsay; 4) Internet; 5) Meetings; 6) Organizations such as the Department of Natural Resources, Restore or Retreat and local government; and 7) "read the feasibility study".

The most frequently occurring responses for those who **neither** favor or oppose the project are: 1) Those who haven't heard of it, including "not sure I have", "new to me", "no", "didn't", "never", "this questionnaire", "this survey", "here", "Q4", and "this piece of paper"; 2) Media, including newspapers, radio, TV and news; 3) People talking, hearsay, friends, patients, and "bits and pieces from various sources"; 4) Meetings and presentations; and 5) The Army Corps of Engineers.

Responses analyzed by Location. There are a few significant relationships found to exist based on the respondents location of residence. More than half (56.7%) of respondents from Thibodaux or north of Thibodaux report that they have not heard of the TDCC project, although 52.8% of respondents south of Thibodaux have heard of the project. Although the overall pattern is that

respondents favored the project, 32% of those residing in Thibodaux or north of Thibodaux oppose the Third Delta project compared to only 10.5% of those living south of Thibodaux.

While the majority of respondents agreed that the project will protect coastal habitat, fewer residents in Thibodaux or north of Thibodaux (54.4%) think that it will compared to those living south of Thibodaux (73%).

Most responded that the project will provide fresh drinking water to area parishes, however the percentage stating it will not in Thibodaux or north of Thibodaux is 17.3 compared to only 4.5% who live south of Thibodaux and think it will not.

Although the majority of respondents think the project will not increase salt water intrusion, there are a substantial number of residents living north of Thibodaux or in Thibodaux who state that they are not sure (33.6%) or think that it will (9.7%).

When asked if they thought that the TDCC project will actually create new deltas in Barataria and Terrebonne Bays the majority believe that it will, but many residents living in Thibodaux or north of Thibodaux expressed uncertainly (40.3%) or think that it will not (4.5%) compared to residents south of Thibodaux where only 28.4% expressed uncertainty or think that it will not create new deltas (1.8%).

Residents all along the bayou are not sure if the project will require the construction of levees that will disrupt the natural runoff from land along the Bayou Lafourche ridge, but more residents in Thibodaux or north of Thibodaux believe it will require levees (37.2%) whereas 21.6% of residents south of Thibodaux believe that it will not require levees to be constructed.

The majority of respondents are not sure if the project will cross Bayou Lafourche, but 20% of residents in Thibodaux or north of Thibodaux believe that it will while 25.5% of residents south of Thibodaux believe that it will not.

Concerning the possibility that bridges will have to be replaced, 26.1% of respondents in Thibodaux or north of Thibodaux believe that it will require the replacement of bridges whereas 27.9% of the respondents from south of Thibodaux think that it will not.

When it came to the remainder of the questions, there are no significant differences in responses for those living in Thibodaux or along the northern section of the bayou, or those living along the southern area of the bayou.

Responses analyzed by Gender. The comparison of responses based on the person's gender uncovered the following differences. Males are more likely to have heard of the TDCC project (52%) whereas females are more likely to have not heard of the project (66.7%). Females are most likely to reply that they are not at all familiar with the project (53.1%) while 68.4% of males claim to be somewhat familiar with the project.

When asked if they thought the project will create coastal habitat 52.3% of females stated that they are not sure while 73.5% of males stated that it will. Females are also more likely to be

uncertain if the project will protect coastal habitat (47%) although many think that it will (40%). Males believe the project will protect coastal habitat (69%), and 23.4% acknowledge that they are not sure.

Sixty-eight percent of males believe that the TDCC project will supply fresh drinking water to area parishes compared to only 22.7% of females. Females are more likely to state that they are not sure (57.6%) about whether the project will do this and 19.7% believe that it will not. On the other hand, only 22.4% of males stated that they are unsure and less than 10 percent said that it will not provide fresh drinking water to area parishes.

The majority of respondents think that the project will benefit the marshes in Terrebonne and Barataria Bays, however 42.4% of females are unsure compared to only 18.6% of males. Females' uncertainty extends to whether the project will make the bay waters muddier (64.6%) while fewer males express uncertainty (43.9%) and 33.2% think that it will. When asked if the bay waters will become fresher as a result of the project 70.3% of males agree that they will compared to only 41.5% of females who think that the bays waters will become fresher.

Males are much more likely to state that the TDCC project will not increase salt water intrusion (69.6%) compared to 37.9% of females who think that it will not result in an increase of salt water intrusion.

When it comes to recreation, 50.8% of males think that the project will create more recreational opportunities compared to 29.2% of females. Males also believe that the project will result in the promotion of tourism (44.1%) whereas females are not sure (68.2%).

Nearly 67% of males responded that the project will result in the creation of new deltas in Barataria and Terrebonne Bays, while 29.2% are not sure that the deltas will emerge. Females are more likely to be not sure (53%) than to think that the deltas will be built by the project (45.5%).

When asked if levees will need to be constructed that will disrupt natural runoff from land along the Bayou Lafourche ridge, the majority of males (51.3%) and females (69.7%) are not sure, while 32% of males and 22.7% of females think that disruptive levees will be constructed.

Concerning the impacts to roads and railroads, a large percentage of females (65.2%) and many males (44.9%) expressed uncertainty at this prospect. However, 39.4% of males think roads and railroads will be impacted compared to 22.7% of females.

The majority of females (78.8%) and males (50.8%) are not sure if the proposed TDCC project will require the extensive relocation of oil and gas pipelines. Slightly more males state that it will not (25.6) than state that it will (23.6%), where as considerably more females state that it will not (13.6%) than state that it will (7.6%).

Most females (81.8%) and over half of the males (59%) are not sure if the TDCC will cross Bayou Lafourche with the possibility of sealing off the upper part of the bayou. Almost 20% of males, and about 8% of females think that it will, but nearly 22% of males and just over 10% of females think that it will not.

Responses analyzed by Education. Education is not as important an explanatory variable as are location or gender, but correlations in response are found. There is a weak, negative correlation found between the respondents level of education and whether the Third Delta conveyance channel will supply area towns with drinking water ($r = -.131$, $\alpha = 0.05$). This can be interpreted to mean that respondents with lower levels of education think that the project will supply drinking water, whereas those with higher levels of education think that the project will not supply fresh drinking water to area communities. A weak, positive correlation existed between the respondents level of education and whether the project will impact roads and railroads ($r = .130$, $\alpha = 0.05$). This means that the lower the level of education, the more likely they are to think that the project will not impact roads and railroads, however the higher the respondents level of education the more likely they are to think that the project will impact roads and railroads. These are the only statistically significant relationships found when analyzing the impact of respondents level of education on the responses to questions about the TDCC project.

Responses analyzed by Income. Income is also used as a variable when attempting to explain respondents answers to questions about the TDCC project. Three statistically significant relationships are found. Respondent's level of income is positively related to familiarity with the project ($r = .383$, $\alpha = 0.01$) and with the project's impact changing fisheries ($r = .149$, $\alpha = 0.05$) but negatively related to whether the project would promote tourism ($r = -.162$, $\alpha = 0.05$). This means that the higher a respondent's income the more likely they are to be very familiar with the TDCC project and the more likely they are to think that the project will change fisheries in the area. Conversely, the lower the respondent income level, the more likely they are to not be at all familiar with the project and the more likely they are to think that the project will not change fisheries. The negative relationship between income and tourism means that the higher the respondents income level the more likely they are to think that the project will not promote tourism. Additionally, the lower the respondents income level, the more likely they are to think that the project will promote tourism. With this said, none of the correlations found are particularly strong.

Summary

The Bayou Lafourche Water Diversion Project. The majority of respondents have heard about the Bayou Lafourche project and favor it's implementation, but familiarity with the projects goals, impacts, and construction vary considerably. Respondents are familiar with the goal of the project to increase the flow of water in the bayou in order to improve it's quality as a source of drinking water to area residents. Most understand the project to be a coastal restoration project that will benefit marshes and coastal habitat through increased creation and protection. Respondents are less familiar with the projects construction and implementation needs. Most are not sure if dredging will be necessary, if bridges will need to be replaced, or if it will be necessary to relocate oil and gas pipelines. They are equally unclear on what will be needed to maintain the increased flow for example, the need for pumping and monitoring stations or the construction of bulkheads.

The respondent's location on the northern or southern portion of the bayou helps to explain their understanding of the project and their opinion of it's implementation. Those located in the northern region are more likely to emphasize the possible negative outcomes associated with the project, including increased salt water intrusion, the potential for flooding, the erosion of bayou

side property, failure to protect marsh habitat or improve the quality of the drinking water or the freshness of the water in the bays. The respondents residing on the southern region of the bayou tend to focus on the more positive aspects of the project.

The respondent's gender made a difference in if they have heard about the project and how familiar they are with the details of the project. Females are less likely to have heard about the project and tend to be less certain about the overall goals and impacts of the project, as well as construction and implementation processes associated with the project.

Respondents overwhelmingly favor the project if they view it as a project to create and benefit coastal marshes. These respondents want action to be taken as soon as possible and see the project as having mostly positive outcomes. Respondents who fear that the project will increase the potential for flooding or place bayou side property in jeopardy of eroding overwhelmingly oppose the project and are more likely to cite the cost as prohibitive. These respondents want to know that these risks can be minimized before supporting implementation.

The Third Delta Conveyance Channel. The majority of respondents have not heard about the Third Delta project, and those who have heard of it vary considerably in their familiarity with the details of the project. Of those respondents who have heard about the project, the majority of them favor its implementation. Respondents admit that they lack information about the project, but most recognize that it is intended as a coastal restoration project. Most are uncertain of its overall goals, design, impacts and implementation.

Respondents' location does influence how much they know about the project and whether they favor it's implementation or not. Opposition to the project is more likely to come from respondents living in the northern region of the bayou. They question whether it will be successful in creating new deltas and they tend to focus on the destructiveness of the project to the environment, the high costs of implementing the project, and the slow return on investment as new deltas will not emerge for many years. Those living along the southern region of the bayou are more likely to think that the project will be successful at creating new deltas in the Barataria and Terrebonne Bays. They tend to stress the benefits that could result from the project and focus on the need to do something now rather than waiting.

Gender did factor into the analysis of the TDCC project. Males claim to be more familiar with the project, especially it's goals and potential impacts. Females are less certain as to the goals of the project and its range of impacts. Overall males and females know little about the design and implementation of the project.

Respondents favor the project if they view it as a project to create and benefit coastal marshes while not destroying the environment. They want action to be taken as soon as possible and see the project as having mostly positive outcomes. Respondents who fear that the project will place them at greater risk for flooding or place existing wetlands in a position of eroding overwhelmingly oppose the project and are more likely to cite the costs to the environment as prohibitive. Before supporting such a project, these respondents want existing channels and canals to be used to create new deltas rather than digging new channels.

Similarities Between Projects. There are some overarching patterns between people's knowledge of and opinion concerning the two proposed projects. If respondent's think the projects are aimed at coastal restoration and improving the marsh, wetlands, and barrier islands of south Louisiana, they tend to be in favor of their implementation. If respondent's think the projects are going to benefit the people of the area, by improving the quality of the drinking water, by increasing opportunities for recreation and promoting tourism, and by potentially creating new commercial or industrial corridors that might lead to increased employment, they tend to be in favor of the projects.

On the other hand, if respondent's think the projects are going to be disruptive to community life, through the possibility of flooding, the need to replace bridges, the construction of levees, impacts to roads and railroads, or having to relocate oil and gas pipelines, they are more likely to oppose the project. If respondent's think the project will be destructive to the environment in it's construction, by having to dredge the bayou or channels, installing pumping stations and monitoring stations, having the initial channel develop over time through an erosion process, or having it cross an existing waterway, they are more likely to oppose the project.

Appendix B: Survey Summary Tables

Table B-1: Respondent's Bayou Lafourche Assessment

The Bayou Lafourche project will...	Will Not	Not Sure	Will	Total*
create coastal wetland habitat	10%	25%	65%	100%
protect coastal wetland habitat	8%	27%	65%	100%
supply fresh drinking water	8%	23%	69%	100%
increase salt water intrusion	71%	21%	8%	100%
cause flooding in Bayou Lafourche towns	47%	37%	16%	100%
change fisheries in the area	16%	41%	43%	100%
benefit marshes in Barataria and Terrebonne Bays	8%	31%	61%	100%
cause the water in the bays to be muddier	30%	46%	24%	100%
cause the water in the bays to be fresher	10%	25%	65%	100%
create more recreational opportunities	12%	40%	48%	100%
promote tourism	22%	47%	31%	100%
require dredging	9%	46%	45%	100%
require relocation of pipelines	30%	57%	13%	100%
require the replacement of bridges	31%	46%	23%	100%
include a pumping station	5%	44%	51%	100%
include monitoring stations	3%	33%	64%	100%
require bulkheads to prevent erosion	13%	46%	41%	100%

* May not total to 100% due to rounding

Table B-2: Respondent's Bayou Lafourche Assessment by Favor and Oppose

	Favor				Oppose			
The Bayou Lafourche project will...	**Will Not**	**Not Sure**	**Will**	**Total***	**Will Not**	**Not Sure**	**Will**	**Total***
create coastal wetland habitat	6%	11%	83%	100%	33%	52%	15%	100%
protect coastal wetland habitat	2%	12%	86%	100%	39%	52%	9%	100%
supply fresh drinking water	4%	15%	81%	100%	33%	30%	36%	100%
increase salt water intrusion	86%	10%	4%	100%	49%	33%	18%	100%
cause flooding in Bayou Lafourche towns	62%	32%	6%	100%	3%	29%	68%	100%
change fisheries in the area	19%	43%	38%	100%	9%	21%	70%	100%
benefit marshes in Barataria and Terrebonne Bays	6%	17%	77%	100%	27%	49%	24%	100%
cause the water in the bays to be muddier	36%	46%	18%	100%	16%	28%	56%	100%
cause the water in the bays to be fresher	6%	18%	77%	101%	44%	19%	38%	101%
create more recreational opportunities	6%	33%	61%	100%	45%	45%	10%	100%
promote tourism	14%	46%	40%	100%	65%	28%	6%	100%
require dredging	11%	39%	50%	100%	6%	50%	44%	100%
require relocation of pipelines	37%	52%	11%	100%	19%	52%	29%	100%
require the replacement of bridges	38%	45%	17%	100%	16%	28%	56%	100%
include a pumping station	6%	40%	54%	100%	7%	32%	61%	100%
include monitoring stations	2%	26%	72%	100%	9%	30%	61%	100%
require bulkheads to prevent erosion	18%	49%	33%	100%	3%	16%	81%	100%

* May not total to 100% due to rounding

Table B-3: Respondent's TDCC Assessment

The Third Delta project will...	Will Not	Not Sure	Will	Total*
create coastal wetland habitat	5%	29%	66%	100%
protect coastal wetland habitat	9%	29%	62%	100%
supply fresh drinking water	12%	31%	57%	100%
cause flooding in Bayou Lafourche towns	36%	48%	17%	100%
change fisheries in the area	13%	36%	51%	100%
benefit marshes in Barataria & Terrebonne Bays	5%	25%	70%	100%
cause the water in the bays to be muddier	22%	49%	29%	100%
cause the water in the bays to be fresher	8%	29%	63%	100%
increase salt water intrusion	61%	32%	7%	100%
create more recreational opportunities	13%	42%	45%	100%
promote tourism	19%	50%	30%	100%
require dredging	9%	46%	46%	100%
require the replacement of bridges	21%	57%	22%	100%
include a pumping station	6%	47%	47%	100%
include monitoring stations	2%	36%	62%	100%
create new deltas in Barataria & Terrebonne Bays	3%	35%	61%	100%
require levee construction that will disrupt natural runoff	14%	56%	30%	100%
impact several roads and railroads	15%	50%	35%	100%
develop over time as the initial channel erodes to the size of the final channels	6%	64%	30%	100%
require relocation of pipelines	22%	58%	20%	100%
cross Bayou Lafourche possibly sealing off the upper part	19%	65%	16%	100%
result in a new highway from the River Road to Hwy 90	6%	77%	17%	100%
open a new commercial and light industrial corridor	6%	61%	33%	100%

* May not total to 100% due to rounding

Table B-4: Respondent's TDCC Assessment by Favor and Oppose

	Favor				Oppose			
The Third Delta project will...	**Will Not**	**Not Sure**	**Will**	**Total ***	**Will Not**	**Not Sure**	**Will**	**Total***
create coastal wetland habitat	1%	12%	87%	100%	26%	30%	44%	100%
protect coastal wetland habitat	2%	12%	87%	101%	33%	41%	26%	100%
supply fresh drinking water	6%	20%	74%	100%	42%	27%	31%	100%
cause flooding in Bayou Lafourche towns	48%	39%	14%	101%	4%	62%	35%	101%
change fisheries in the area	18%	34%	49%	101%	7%	26%	67%	100%
benefit marshes in Barataria & Terrebonne Bays	0%	10%	90%	100%	26%	22%	52%	100%
cause the water in the bays to be muddier	25%	44%	31%	100%	12%	39%	50%	101%
cause the water in the bays to be fresher	3%	14%	83%	100%	26%	30%	44%	100%
increase salt water intrusion	81%	16%	4%	101%	52%	26%	22%	100%
create more recreational opportunities	8%	31%	61%	100%	41%	41%	18%	100%
promote tourism	14%	41%	44%	100%	42%	42%	15%	100%
require dredging	12%	42%	46%	100%	7%	30%	63%	100%
require the replacement of bridges	28%	49%	23%	100%	22%	44%	33%	100%
include a pumping station	6%	40%	54%	100%	15%	33%	52%	100%
include monitoring stations	1%	32%	67%	100%	4%	30%	67%	101%
create new deltas in Barataria & Terrebonne Bays	2%	18%	80%	100%	12%	40%	48%	100%
require levee construction that will disrupt natural runoff	21%	57%	21%	100%	7%	32%	61%	100%
impact several roads and railroads	20%	45%	35%	100%	11%	29%	61%	101%
develop over time as the initial channel erodes to the size of the final channels	7%	64%	30%	101%	7%	29%	64%	100%
require relocation of pipelines	35%	53%	12%	100%	11%	36%	54%	101%
cross Bayou Lafourche possibly sealing off the upper part	29%	60%	11%	100%	11%	37%	52%	100%
result in a new highway from the River Road to Hwy 90	8%	74%	18%	100%	11%	63%	26%	100%
open a new commercial and light industrial corridor	5%	53%	42%	100%	18%	46%	36%	100%

* May not total to 100% due to rounding

Table B-5: Respondent's Gender

Sex	Number	Percent
Male	208	26.0%
Female	73	74.0%
Total	281	100.0%

Table B-6: Respondent's Education

Education	Number	Percent
Less than High School	16	6.0%
HS Diploma or GED	66	24.0%
Some college/tech school	68	25.0%
College/tech school diploma	81	29.0%
Professional degree	47	17.0%
Total	278	100.0%

Table B-7: Respondent's Location

Region/Location	Number	Percent
North of Thibodaux	49	17.0%
Thibodaux	102	35.0%
South of Thibodaux	114	40.0%
Not on bayou or not given	22	8.0%
Total	287	100.0%

Table B-8: Respondent's Ethnicity

Ethnicity	Number	Percent
Asian	1	0.4%
Black	9	3.2%
Hispanic	2	0.7%
Native American	4	1.4%
White	246	87.9%
Other	18	6.4%
Total	280	100.0%

Table B-9: Respondent's Income

Income	Number	Percent
Less than $11000 per year	4	2.0%
$11000 to 20000	10	4.9%
$21000 to 30000	21	10.3%
$31000 to 40000	31	15.2%
$41000 to 50000	23	11.3%
$51000 to 60000	18	8.8%
$61000 to 70000	14	6.9%
$71000 to 80000	26	12.7%
$81000 to 90000	15	7.4%
$91000 to 100000	26	12.7%
More than $100000	16	7.8%
Total	204	100.0%

Table B-10: Respondent's Age

Age	Number	Percent
21 and under	3	1.1%
22 to 30	19	6.8%
31 to 40	44	15.7%
41 to 50	60	21.4%
51 to 60	61	21.8%
61 to 70	62	22.1%
71 to 80	25	8.9%
81 to 90	6	2.1%
Total	280	100.0%